June 2003

Economic Analysis of Management Alternatives for Personal Watercraft in Lake Meredith National Recreation Area

Revised Final Report

Prepared for

Dr. Bruce Peacock
National Park Service
Environmental Quality Division

Prepared by

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Contents

Figures

Tables

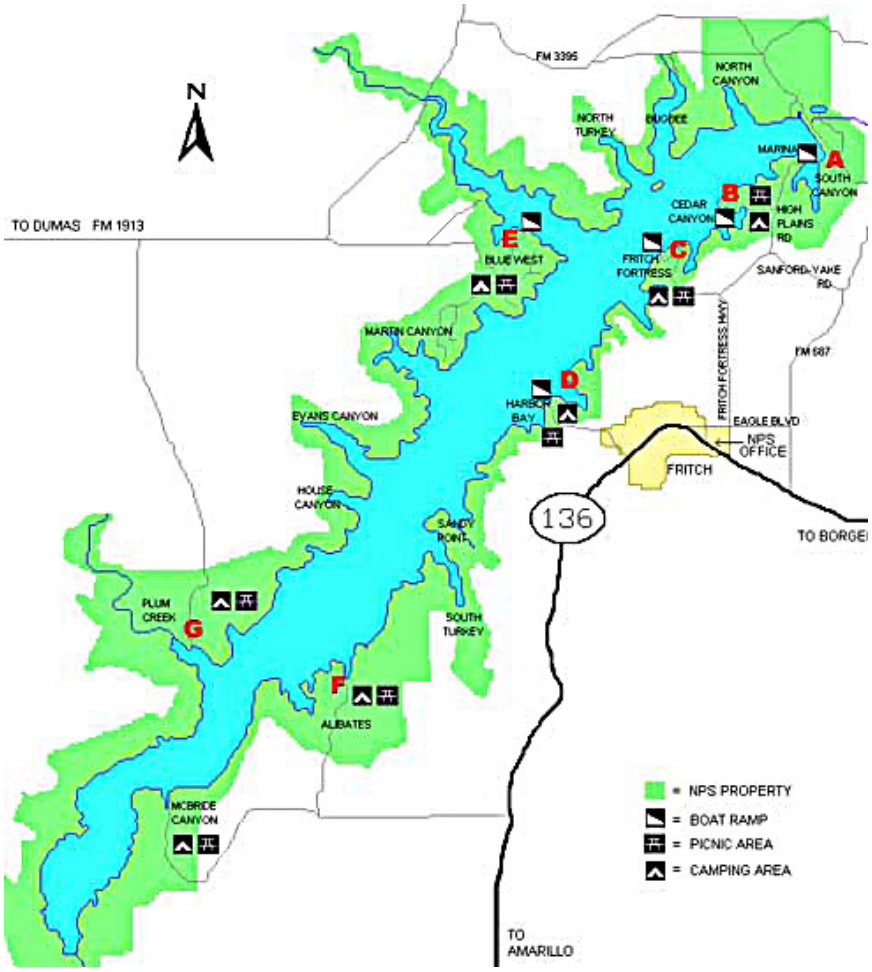
1 Introduction

Historically, NPS classified PWC with other water vessels, which allowed their use when the use of other vessels was permitted. More recently, NPS has reevaluated its methods of PWC regulation. This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in Lake Meredith National Recreation Area (LAMR).

Historically, the National Park Service (NPS) classified personal watercraft (PWC) with all other water vessels, which allowed people to use PWC when the use of other vessels was permitted by a Superintendent's Compendium.[1] In recognition of its duties under the Organic Act and NPS Management Policies, as well as increased awareness and public controversy, NPS reevaluated its methods of PWC regulation. Because of new information regarding potential resource impacts, conflicts with other users, and safety concerns associated with PWC use, NPS proposed a PWC-specific regulation in 1998. The regulation stipulated that PWC would be prohibited in units of the national park system unless NPS determines that PWC use is appropriate for a specific unit based on that unit's enabling legislation, resources and values, other visitor uses, and overall management objectives (63 FR 49,312–17, September 15, 1998). This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in Lake Meredith National Recreation Area (LAMR), which is located in the Texas panhandle (see Figure 1-1).

[1] A compendium is an NPS management tool used specifically by a park superintendent to take actions to address park-specific resource protection concerns.

Figure 1-1. Map of LAMR



During a 60-day comment period, NPS received nearly 20,000 comments on this proposed regulation. As a result of public comments and further review, NPS promulgated an amended regulation in March 2000. This amended regulation allows NPS to permit PWC use in 11 units by promulgating a special regulation and in an additional 10 units by amending the Superintendent's Compendiums (36 CFR 3.24[b], 2000). The March 2000 regulation provided park units a 2-year grace period in which PWC use could continue, after which time PWC would be banned from any park that took no action to promulgate either PWC-specific regulations or to regulate PWC use in the Superintendent's Compendium.

On August 31, 2000, Bluewater Network et al. filed a complaint with the United States District Court for the District of Columbia against NPS alleging, among other things, that the NPS rule-making

decisions to allow PWC use in some park units after 2002 by making entries in Superintendent's Compendiums would not provide the opportunity for public input. In addition, the environmental group claimed that because PWC cause water and air pollution, generate noise, and pose public safety threats, NPS acted arbitrarily and capriciously when making its September 1998 and March 2000 decisions.

A settlement agreement between NPS and Bluewater Network was signed by the District Court on April 12, 2001. The agreement requires all park units wishing to continue PWC use to promulgate special regulations only after each unit conducts an environmental analysis in accordance with the 1969 National Environmental Policy Act (NEPA). At a minimum, the NEPA analysis must evaluate the impacts of PWC on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. In addition, NPS is required by federal statutes, including Executive Order 12866, to conduct a benefit-cost analysis of the proposed regulation and analyze the impact of the regulation on small businesses under the Regulatory Flexibility Act (RFA) of 1980. Based on this settlement, PWC use in LAMR was to be prohibited after September 15, 2002, if a final rule permitting their use was not promulgated. However, a stipulated modification to this settlement agreement was approved by the court on September 9, 2002, that permitted PWC use in LAMR until November 6, 2002. After that date, PWC use in LAMR is prohibited until the final rule is published.[2] This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in LAMR, as required by the terms of the April 2001 settlement and by applicable federal statutes.

1.1 ORGANIZATION OF REPORT

This report presents NPS's economic analysis of the alternative LAMR PWC regulations under consideration. The report is organized as follows. Section 1 describes the reason for the regulation and the current and proposed regulations at LAMR. Baseline visitation, environmental conditions, and economic

[2]Under the no-action alternative, PWC use would continue to be banned.

activity in LAMR are described in Section 2. The local economic impacts on the region surrounding LAMR are summarized in Section 3. Section 4 describes the methodology for assessing the impacts of the alternatives on social welfare and presents a cost-benefit analysis of the regulatory alternatives. Section 5 provides an analysis of the regulatory alternatives' impacts on small businesses. Uncertainties are addressed in Section 2 for visitation, Section 3 for regional economic impacts, and Section 5 for the alternatives' impacts on businesses. In addition, Appendix A describes the principles of economic impact analysis, and Appendix B includes a detailed theoretical discussion of the types of benefits and costs associated with PWC restrictions in national parks and the methods used in their measurement.

1.2 PROBLEM ADDRESSED BY REGULATION

In general, regulations should be imposed only where a market failure exists that cannot be resolved efficiently by measures other than federal regulation. The justification for restricting PWC use in national parks is based on externalities associated with their use.

The U.S. Office of Management and Budget (OMB) directs regulatory agencies to demonstrate the need for their rules (OMB, 1992). In general, regulations should be imposed only where a market failure exists that cannot be resolved efficiently by measures other than federal regulation. If each producer and consumer has complete information on his or her actions and makes decisions based on the full costs of those actions, resources will be allocated in a socially efficient manner. However, when the market's allocation of resources diverges from socially optimal values, a market failure exists. A defining feature of a market failure is the inequality between the social consequences of an action and a purely private perception of benefits and costs. The major causes of market failure identified in the OMB guidance on Executive Order 12866 are externalities, natural monopolies, market power, and inadequate or asymmetric information. For environmental problems resulting from market failures, this divergence between private and social perspectives is normally referred to as an externality. Such divergences occur when the actions of one economic entity impose costs on parties that are external to, or not accounted for in, a market transaction or activity.

The justification for restricting PWC use in national parks is based on externalities associated with their use. For instance, the operation of PWC imposes costs on society associated with noise emissions, air and water pollution emissions, and health and safety

risks. Because PWC users have little incentive to consider these external costs, they are likely to make decisions about PWC use without taking these impacts on other people into account.

If these externalities are internalized to the PWC users generating them, the problem can be mitigated. For example, if PWC users were required to pay for the marginal external costs they impose on others, they would begin to take those costs into account when making decisions and the market failure would be corrected. However, accurately assigning costs associated with each individual PWC user's actions and enforcing payment is essentially not feasible at this time. Other regulatory options to address the externalities associated with PWC use are far easier to implement and enforce. Some of these options include restricting areas where they are permitted, the time of day when they can be used, and PWC engine type.

The extent to which social welfare improves because of PWC regulation depends on the relative costs and benefits associated with such restrictions. Although non-PWC users gain from PWC restrictions, the PWC users and local businesses that serve them experience welfare losses.

The extent to which social welfare improves because of PWC regulation depends on the relative costs and benefits associated with such restrictions. Although non-PWC users gain from PWC restrictions, the PWC users and local businesses that serve them experience welfare losses. Thus, the likelihood that a particular regulatory option will improve social welfare in an individual national park unit depends on numerous park-specific factors that influence the level of costs and benefits. Although a given set of restrictions on PWC use in one park may improve social welfare, the same set of restrictions in another park could easily have negative impacts on social welfare. For example, banning PWC in a park where there is little other motorized boating activity may result in large proportionate reductions in noise and emissions, whereas banning PWC in a park with a high level of other motorized boating activity may not have a noticeable effect on noise or emissions levels. In the latter case, the costs to PWC users could be larger than the gains to other park visitors. Thus, it is important to consider the conditions specific to each individual park in selecting the preferred regulatory alternative for that park.

1.3 CURRENT PWC ACTIVITIES

PWC use is currently prohibited in LAMR. In accordance with the September 9, 2002, stipulated modification to the April 2001 settlement agreement, PWC use in LAMR was prohibited after

November 6, 2002, until a final rule authorizing its use is promulgated. For the purposes of the analyses in this report, the PWC ban is considered baseline conditions in LAMR.

1.4 PROPOSED REGULATIONS

The following three alternatives are being considered for the management of PWC in LAMR:

Proposed Regulations for PWC Use in LAMR

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation

Alternative B: Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation

Alternative C: No Action (Continue PWC Ban)

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation

Under Alternative A, PWC use at LAMR would be reinstated under a special regulation that includes the provisions set forth in the current Superintendent's Compendium as follows:

- The stilling basin below Sanford Dam is closed to all boating and hunting, including any vessel or device propelled by hand, sail or machinery, or rigid or inflatable construction, and used for support.
- Operating a vessel without a special permit in excess of 5 mph or creating a wake is prohibited in all marked "No Wake" areas on the lake.
- Launching of boats is permitted at the following developed launch ramps:
  - ✓ Sanford-Yake—all vessels year-round;
  - ✓ Cedar Canyon—all vessels year-round;
  - ✓ Fritch Fortress—all vessels year-round;
  - ✓ Harbor Bay—all vessels year-round;
  - ✓ Blue West—all vessels year-round;
  - ✓ Bates Canyon—all vessels year-round if water level is high enough, otherwise closed;
  - ✓ Plum Creek—all vessels year-round if water level is high enough, otherwise closed;
  - ✓ Primitive Areas—small vessels during the waterfowl hunting season.

Alternative A would allow for unrestricted use of the lake, with the provisions outlined above. Use would be managed under the following provisions:

- Conduct water patrols and enforcement on an irregular basis (a less than daily occurrence).

- Enforce the Texas Parks and Wildlife Code relating to PWC use, as summarized in Table 1-1. Additional Texas water safety regulations can be found in a Texas Parks and Wildlife publication (2001).

Table 1-1. Texas Parks and Wildlife Code Applicable to PWC

Category	Regulation
Time of operation	➤ No PWC operation allowed between sunset and sunrise.
Operating restrictions	➤ No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed. ➤ Operator must be 16 years of age, be accompanied by a person at least 18 years of age, or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state. ➤ No PWC may be operated in any area where motorboat use is prohibited by state law or local rule or regulation. ➤ No towing water skis, an aquaplane, a surfboard, a tube, or any similar device, unless the craft is designed to carry a minimum of two persons. ➤ No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel. ➤ No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.
Safety	➤ Each occupant must wear a U.S. Coast Guard-approved personal flotation device. ➤ The cutoff switch (if provided) must be attached to the operator.

Source: National Park Service (NPS). 2003. *Lake Meredith National Recreation Area: Personal Watercraft Use Environmental Assessment.* Washington, DC: U.S. Department of the Interior.

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation

Alternative B would reinstate PWC use under a special regulation that would allow PWC operation similar to Alternative A, as above, but use would be restricted to reduce user conflicts and to protect water resources. The following management strategies would be adopted:

- Establish the following back coves on the lake as no-wake zones: North Turkey, Bugbee Canyon, North Canyon, South Canyon, Sexy Canyon, Amphitheater Cove, coves between day markers 9 and 11, Fritch Canyon, and Short Creek (plus Evans Canyon and Canal Canyon should the water level

ever get high enough). A map of the lake would be developed to identify these no-wake zones, and they would be clearly marked with buoys. Maps would be posted at the park, and informational pamphlets would be made available to the public.

- ➤ Enhance PWC user education through interpretive talks, onsite bulletins, and brochures for PWC registrants and visitors who rent PWC. Educate PWC users about the advantages of using watercraft with cleaner-burning engines.
- ➤ Prohibit PWC fueling on the lake except at the marina fuel dock, with an attendant providing the fuel service.
- ➤ Permit PWC fueling by operators onshore and out of the water.
- ➤ Prohibit carrying of extra fuel on PWC.
- ➤ Continue to monitor water quality tests on Lake Meredith available from other agencies.

All Texas and federal watercraft laws and regulations, as described for Alternative A, would apply to PWC operators, including regulations that address reckless or negligent operation, excessive speed, hazardous wakes or washes, hours of operation, age of driver, and distance between vessels.

Alternative C: No-Action (Continue PWC Ban)

Under the no-action alternative, no unit-specific rule would be developed to reinstate PWC use in LAMR. Therefore PWC use would be prohibited in LAMR permanently, in accordance with Bluewater Network v. Stanton, No. CV02093 (D.D.C. 2000), the settlement agreement approved by the court on April 12, 2001, and subsequent September 9, 2002, modification.[3]

[3]As noted above, PWC are currently banned from LAMR until the publication of the final rule for management of PWC use in the park. Under the no-action alternative, this temporary ban would become permanent.

2 Description of PWC Use in Lake Meredith National Recreation Area

PWC use in LAMR could have negative impacts on water and air quality, soundscapes, wildlife and wildlife habitats, and cultural and ethnographic resources. However, because of the relatively small number of PWC used in LAMR, baseline PWC use is estimated to impose only minimal incremental impacts on these resources.

LAMR is located near the center of the Texas Panhandle in the High Plains region, approximately 40 miles north of Amarillo, Texas. Lake Meredith was created by the construction (beginning in 1962) of the Sanford Dam on the Canadian River and has been used for outdoor recreation since 1965. In 1990, the area was officially classified as a national recreation area.

LAMR provides recreation opportunities for more than one million visitors each year, as well as water for 500,000 people in 11 cities. LAMR extends for 22 miles across portions of Moore, Hutchinson, and Potter Counties (see Figure 1-1). It is one of the premier prairie parks in the Great Plains, comprising 46,349 acres of canyonland and grassland. LAMR also includes the Alibates Flint Quarries National Monument, located approximately 12 miles east of Lake Meredith.

2.1 PWC USE, AREA ACCESS, MAINTENANCE, AND ENFORCEMENT AT LAMR

Although PWC are currently banned in LAMR (see Section 1.3), this section reviews PWC access, maintenance, and enforcement prior to the ban. PWC were first used in LAMR in the mid-1970s. Use increased during the late 1970s and early 1980s and continued to grow moderately for the next two decades. Depending on weather, the typical PWC use season lasted from mid-May to mid-September,

or from mid-April to October. LAMR has seven developed boat launch sites: Blue West, Sanford-Yake Marina, Cedar Canyon, Harbor Bay, Fritch Fortress, Plum Creek, and Bates Canyon. Because most of the lake is bordered by steep, rocky canyons, access to Lake Meredith from nondesignated areas is limited. However, PWC users could launch at Bugbee Creek, where there is drive-in access to the shoreline.

LAMR did not provide any facilities solely for PWC users. Boat launches were shared with other watercraft, and land-based facilities such as restrooms and picnic areas are used by all park visitors. Maintenance associated with PWC therefore was considered incidental to other park operational costs. PWC operators on Lake Meredith were required to abide by Texas boating laws and regulations (see Table 1-1). LAMR staff indicated that the costs of enforcing PWC regulations were considered incidental to enforcement of general boating regulations, because no funding or personnel were dedicated exclusively to enforcement of PWC regulations at LAMR. Boating regulations are enforced primarily by Texas Parks and Wildlife patrols (one to six officers on summer weekends), with fewer patrols by the Coast Guard Auxiliary (one to two boats on holiday weekends) and NPS. Between 1997 and 2001, 393 written violation notices were issued to all watercraft operators on Lake Meredith. Of these notices, 271 were issued to boat operators and 122 to PWC users (NPS, 2003). The majority of PWC citations involved no-wake zone violations (37) and failure to pay the required recreation fee (31). Table 2-1 provides a breakdown of PWC and boating citations issued. Between 1997 and 2001 there were 19 recorded watercraft accidents, 13 involving boats and six involving PWC. Of the six PWC-incidents, one resulted in "extensive damage" (NPS, 2003).

2.2 VISITATION DATA

Sections 3 and 4 present analyses of the economic impacts and the social benefits and costs of PWC use under alternative regulations in LAMR from 2003 through 2012. To support the development of these estimates, Section 2.2 presents projections of baseline PWC and non-PWC visitation for this period and discusses the methodology used to calculate the projections. The projected baseline represents visitation

Table 2-1. PWC and Boating Violation Notice Breakdown for LAMR, 1997–2001

Type of Violation	PWC	Boats
No-wake zone violation	37	22
Failure to pay recreation fee	31	115
Improper towing	14	31
Lack of personal flotation device	6	52
Alcohol	—	11
Other	34	40
Total	122	271

Source: National Park Service (NPS). 2003. *Lake Meredith National Recreation Area: Personal Watercraft Use Environmental Assessment.* Washington, DC: U.S. Department of the Interior.

to LAMR after imposing the ban on PWC use, as discussed in Section 1. In addition, projected visitation expected to have occurred in the absence of the ban is presented.

2.2.1 Historical LAMR Visitation Data

Visitation to LAMR has ranged from about 1.2 and 1.9 million visitors annually over the last 2 decades (see Table 2-2). Table 2-3 presents the 2001 monthly visitation estimates for LAMR. According to NPS reports, the estimated total number of recreational visitors to the LAMR area in 2001 was 1,248,278. Between the months of May and September, the typical PWC season, LAMR received 789,147 visitors (63 percent of annual visitation). NPS estimated the total number of recreational visitors based on road traffic counts at 12 park entrances and multiplication of these counts by the estimated number of people per party (3.5) to account for the number of people per vehicle.

As shown in Table 2-2, visitation to LAMR has fluctuated over the last 2 decades, but fewer people visited LAMR in 2001 than in any other year during this period. This drop in attendance has been attributed to an outbreak of bubonic plague affecting prairie dogs (NPS, 2002a).

Table 2-2. Annual Recreational Visitation to LAMR, 1979–2001

Year	Total Visitation	Year	Total Visitation
1979	1,849,425	1991	1,280,021
1980	1,570,790	1992	1,296,962
1981	1,559,283	1993	1,480,987
1982	1,909,655	1994	1,535,448
1983	1,844,870	1995	1,470,137
1984	1,944,648	1996	1,676,466
1985	1,597,719	1997	1,683,646
1986	1,406,693	1998	1,636,419
1987	1,280,496	1999	1,779,138
1988	1,321,739	2000	1,615,751
1989	1,274,916	2001	1,248,278
1990	1,358,778		

Source: National Park Service (NPS). 2002c. "Park Visitation Report." <http://www2.nature.nps.gov/stats/>. As obtained April 2002.

Table 2-3. Monthly Recreational Visitation to LAMR, 2001

Month	Recreational Visits
January	20,701
February	40,026
March	83,969
April	105,012
May	161,606
June	223,377
July	184,029
August	142,644
September	77,491
October	90,927
November	67,273
December	51223
Total	1,248,278

Source: National Park Service (NPS). 2002c. "Park Visitation Report." <http://www2.nature.nps.gov/stats/>. As obtained April 2002.

2.2.2 Historical LAMR Watercraft Visitation Data

Watercraft visitation data were collected only when LAMR officials were on patrol. According to LAMR personnel, PWC accounted for approximately 20 percent of all watercraft used on Lake Meredith each year. Park staff estimate that 4,075 PWC were used in LAMR in 2001. Estimates provided by LAMR staff indicate that the average group size for PWC visitors is approximately 3.5 people per PWC (NPS, 2002b). Based on this group size, NPS estimates that about 14,263 people used PWC in LAMR during 2001, which equates to approximately 1.14 percent of total 2001 LAMR visitation. However, park officials noted that there is considerable uncertainty surrounding this estimate of PWC visitation (NPS, 2002b).

Most PWC users come to LAMR for the day, although some camp and launch their PWC from shore. Visitors to LAMR include those exclusively using PWC and those who also bring fishing boats or houseboats. According to park staff, most visitors to LAMR (including PWC users) travel less than 150 miles from Texas Panhandle communities, although people frequently visit from Kansas, Colorado, New Mexico, and other parts of Texas. The PWC historically used in LAMR were typically two- to three-person machines with conventional two-stroke engines. Very few rentals were available in LAMR (three to four machines in 2002, none in 2001). As such, most PWC users visiting LAMR likely owned their own PWC.

Absent additional information on PWC use in LAMR, NPS assumes that LAMR park staff have the best available data on total PWC visitation to the park.

Data collected by NPS from local bait and convenience stores suggest that PWC visitation may have been much higher. These businesses estimated that between 15 and 33 percent of their annual revenue was attributable to PWC users.[1] This information seems consistent with the share of watercraft used in LAMR that are PWC, but it is not consistent with the proportion of all visitors to LAMR estimated to be PWC users. It is possible that the businesses contacted have a much higher proportion of sales to PWC users than area businesses overall, or that they cater to watercraft users. Absent additional information on PWC use in LAMR, NPS assumes that LAMR park staff have the best available data on total PWC visitation to the park. Thus, LAMR park staff estimates of PWC use

[1] PWC rental, sales, and service shops contacted by NPS indicated that the share of annual revenue derived from PWC-related activities ranges from less than 5 percent to 25 percent.

are the primary values used in the economic analyses, although impacts based on visitation implied by the businesses' estimates are also discussed.

2.2.3 Projected Visitation

Methodology for Projecting Visitation

To project PWC and non-PWC visitation for the years 2003 through 2012, NPS used the following methodology:

Baseline

1. Calculate average recreational visitation over the five most recent years with data available (1997–2001).
2. Divide the recreational visitation estimated in Step 1 between PWC and non-PWC visitation using estimates of PWC use in 2001 relative to total recreational visits.
3. Project baseline non-PWC visitation for the period 2003–2012 by allowing non-PWC visitation to change from the 1997–2001 average at the population growth rate for the areas from which most visitors to the park originate. The average annual growth of the regional population[2] from 1990 to 2000 was 1.05 percent (U.S. Census Bureau, 2002).
4. Assume there would be no PWC use in 2003–2012 under baseline conditions because of the current ban on PWC use in LAMR.
5. Project visitation by former PWC users by assuming a certain fraction will continue to visit LAMR to engage in activities other than PWC use following the ban. These percentages will typically be based on professional judgment, because of the absence of a formal study of PWC use in LAMR.

Without Ban

1. Calculate average recreational visitation over the five most recent years with data available (1997–2001).
2. Divide the recreational visitation estimated in Step 1 between PWC and non-PWC visitation using an estimate of 14,263 PWC users in 2001. This results in an estimate of PWC users accounting for 1.14 percent of visitation.
3. Estimate PWC visitation for 2003–2012 by using the estimates of annual growth in PWC use presented in the Environmental Assessment (EA) of PWC use at LAMR (NPS, 2003). Although the numbers of PWC registered are declining in Texas and in the counties surrounding LAMR

[2]Armstrong, Carson, Hutchinson, Lubbock, Moore, Potter, and Randall Counties.

(TPWD, 2003),[3] park staff estimate that PWC use would continue at pre-ban levels in the future (NPS, 2003). It is assumed here that park staff have the best information available for predicting future PWC use in LAMR, despite data from PWC registrations indicating a decline in the number of PWC registered both in the panhandle of Texas and statewide.

Projecting Visitation for 2003 through 2012

Following the methodology outlined above, NPS calculated LAMR average annual recreational visitation for 1997 through 2001 to be 1,592,646. According to NPS estimates, approximately 1.14 percent of 2001 visitors used PWC in LAMR. Assuming that the percentage of PWC visitors remained relatively constant over time, this implies an annual average of 18,197 PWC users and 1,574,449 non-PWC users from 1997 to 2001.

LAMR staff estimate that future PWC use in the park would have remained relatively constant at pre-ban levels in the absence of the ban.

As described above, NPS projects that non-PWC visitation will grow at the rate of population growth for the areas where most visitors to LAMR originate. In the absence of a ban, visitation by PWC users was projected assuming that PWC use will remain constant over time. NPS believes that most visitors originate from the surrounding area including the cities of Amarillo and Lubbock, which are the largest cities in the region. According to the Census Bureau, population in the seven Texas counties surrounding the park[4] experienced an average population growth rate of 1.05 percent annually from 1990 to 2000 (Census Bureau, 2002). This is only slightly above the national average of 0.9 percent.

For 2003 to 2012, there is assumed to be no baseline PWC use in the park because PWC are banned in the baseline as of November 2002. However, many of the former PWC users who can no longer use a PWC in LAMR may continue to visit the park to pursue other types of recreation. It was assumed that 80 percent of PWC users would continue to visit the LAMR park region under the ban. This percentage is based on professional judgment and reflects the uniqueness of LAMR compared with other recreation areas in the

[3]PWC registrations declined by an average of approximately 20 percent per year from 1998 to 2002 in the seven counties around LAMR identified for this analysis (Armstrong, Carson, Hutchinson, Lubbock, Moore, Potter, and Randall). Statewide, PWC registrations fell by approximately 10 percent per year over the same period (TPWD, 2003).

[4]The seven counties around LAMR identified for this analysis are Armstrong, Carson, Hutchinson, Lubbock, Moore, Potter, and Randall.

region. Based on the estimated regional population growth rate, the projected constant level of PWC use, and the assumed percentage of former PWC users who stop using PWC in the park that will continue to visit the park for other activities, NPS presents the projected baseline visitation for LAMR from 2003 to 2012 in Table 2-4.

Table 2-4. Projected Baseline Visitation to LAMR, 2003–2012[a]

		Non-PWC Users			
Year	PWC Users	Non-PWC Users in the Absence of the Ban	Visitors that Would Have Used PWC in the Absence of the Ban[b]	Total Non-PWC Users	Total Visitation
2003	0	1,584,458	14,558	1,599,015	1,599,015
2004	0	1,601,095	14,558	1,615,653	1,615,653
2005	0	1,617,907	14,558	1,632,465	1,632,465
2006	0	1,634,896	14,558	1,649,454	1,649,454
2007	0	1,652,063	14,558	1,666,621	1,666,621
2008	0	1,669,411	14,558	1,683,969	1,683,969
2009	0	1,686,941	14,558	1,701,498	1,701,498
2010	0	1,704,654	14,558	1,719,212	1,719,212
2011	0	1,722,554	14,558	1,737,112	1,737,112
2012	0	1,740,642	14,558	1,755,199	1,755,199

[a]These projections are based on the estimated regional population growth rate, the assumed constant level of PWC use, and the assumed percentage of former PWC users who voluntarily stop using PWC in the park who will continue to visit the park for other activities. There is no PWC use in the park after November 2002, under baseline conditions because PWC were banned on that date.

[b]This category represents visitors who would have used PWC in LAMR in the absence of the ban but would continue to visit the park to engage in alternative activities following the ban. These values were calculated based on an assumption that 80 percent of people who would have used PWC in the park in the absence of the ban would continue to visit the park to engage in alternative activities.

To estimate the incremental impacts of the alternative management strategies (see Sections 3 and 4), the change in visitation relative to these baseline conditions must be projected. Table 2-5 presents the projected visitation that would have taken place in the absence of the November 2002 ban on PWC use in LAMR.

Table 2-5. Projected Visitation to LAMR in the Absence of the Ban on PWC Use, 2003–2012

Year	PWC Users	Non-PWC Users	Total Visitation
2003	18,197	1,584,458	1,602,655
2004	18,197	1,601,095	1,619,292
2005	18,197	1,617,907	1,636,105
2006	18,197	1,634,896	1,653,093
2007	18,197	1,652,063	1,670,261
2008	18,197	1,669,411	1,687,608
2009	18,197	1,686,941	1,705,138
2010	18,197	1,704,654	1,722,851
2011	18,197	1,722,554	1,740,751
2012	18,197	1,740,642	1,758,839

2.2.4 Sources of Uncertainty in Visitation Projections

NPS estimates of PWC and non-PWC visitation in the years 2003 through 2012 are based on a number of assumptions. In addition, a variety of unpredictable circumstances could affect visitation in a particular year. In general, visitation to LAMR in a specific year will depend on many factors, including

- economic conditions,
- weather,
- natural resource conditions,
- national and state regulations that may affect PWC use or prices,
- alternative recreational activities available, and
- other infrequent events that may occur in a given year that affect visitation (e.g., 2001 bubonic plague affecting prairie dogs in LAMR).

Although many of these factors are difficult to predict, a recent regulation enacted by the U.S. Environmental Protection Agency (EPA) in 1996 may affect PWC use nationally and in LAMR. The 1996 EPA rule for New Gasoline Spark-Ignition Marine Engines[5] (hereafter referred to as the 1996 EPA Marine Engine Rule) requires

[5]In 1996, EPA promulgated a rule to control exhaust emissions from new spark-ignition marine engines, including outboards and PWC. Emission controls provide for increasingly stricter standards beginning in model year 1998, with all PWC manufactured after 2006 required to be EPA emissions-compliant (i.e., to reduce hydrocarbon emissions by 75 percent from unregulated levels) (*Federal Register*, 1996).

PWC (and other spark-ignition [SI] marine engine) manufacturers to reduce emissions by 75 percent from the 1998 model year until the 2006 model year (*Federal Register*, 1996). In their analysis of the rule, EPA predicted that the emissions from all of the regulated engines in use will decrease by approximately 75 percent from baseline emission levels by the year 2025. The delay in actual emission reductions for machines in use is due to the long lives of some marine engines. EPA predicts that complete fleet turnover for some engines may not occur until 2050. However, EPA assumes that the life cycle for PWC is 10 years, considerably shorter than their assumptions for the life cycles of some of the other SI marine engines covered by the rule (*Federal Register*, 1996). According to the Personal Watercraft Industry Association (PWIA), PWC manufacturers have already reduced the emissions of PWC significantly, and many of the newer PWC models already comply with the 1996 EPA Marine Engine Rule (PWIA, 2002).

Without additional data, it is difficult to predict whether the assumptions used by NPS will bias the projections upward or downward.

It is also possible that publicity surrounding the proposed NPS PWC rules may have affected PWC use. PWC sales have been declining nationally over the past few years. However, the sales decline began in 1996, which is before NPS first proposed rules restricting PWC in national parks. This suggests that other factors also may be involved in the national recent sales decline. Nonetheless, it is possible that baseline PWC use would have been higher in the absence of recent negative publicity.

NPS identified the following additional uncertainties in the projections of baseline visitation:

- The estimate of 2001 PWC use represents the park's best estimate of use. However, LAMR staff have not conducted a rigorous count of PWC throughout the season.
- NPS estimates of total visitation to LAMR are based on traffic counters and an assumed group size of 3.5 people per party. To the extent that the actual average group size differs from 3.5 for either overall visitation or PWC users in particular, visitation estimates for these groups may be biased upward or downward.
- NPS projects growth in non-PWC visitation based on population growth in the surrounding counties and in nearby metropolitan areas. As discussed above, a number of factors could affect visitation in any one year or the trend in visitation over time. However, NPS believes that regional population growth, which should be related to economic

conditions, represents the best available proxy for change in visitation.

- NPS makes assumptions about the number of former PWC users who will return in the future under the existing ban. These assumptions represent our best estimate, but the actual percentage of former PWC users who continue to visit the park for alternative recreation activities may be higher or lower.
- NPS expects that PWC use at LAMR will remain relatively constant over time. This estimate is based on observations of park staff. As explained earlier, PWC registrations in local counties and across the state of Texas declined sharply from 1998 to 2001. Consequently, future PWC use may be overestimated here. However, without further information, such as a formal count of PWC over time at LAMR, NPS assumes that the professional judgment of park staff is the most credible basis for predicting future PWC use.

2.3 ALTERNATE LOCATIONS FOR PWC USE IN THE TEXAS PANHANDLE REGION

Alternate locations for PWC use in the Texas Panhandle region are limited but include Greenbelt Lake (approximately 65 miles from Amarillo), Buffalo Springs Lake (128 miles from Amarillo), and Lake Texoma (347 miles from Amarillo). Lake Meredith is the largest public lake within at least 250 miles of Amarillo and is the primary boating destination for the area.

2.4 OTHER MAJOR SUMMER ACTIVITIES IN LAMR

Summer recreation activities in LAMR include boating, fishing, water skiing, swimming, scuba diving, off-road vehicle use, hunting, picnicking, hiking, backpacking, camping, horseback riding, bird-watching, nature viewing, and visiting the Alibates Flint Quarries. Lake Meredith is one of the primary fishing destinations in the area, particularly for walleye, pike, smallmouth bass, largemouth bass, and black bass.

2.5 NATURAL RESOURCES AND LIKELY ECOLOGICAL IMPACTS OF PWC USE IN LAMR

The following section summarizes key information regarding natural resources at LAMR and an assessment of the potential impacts to

park resources under the proposed PWC management alternatives identified in Section 1.4. Interviews with LAMR personnel and conclusions from the EA for LAMR provide the basis for this analysis. Details of the analysis, including guiding regulations and policies and methodologies and assumptions, are described in the *Lake Meredith National Recreation Area Personal Watercraft Use Environmental Assessment* (NPS, 2003). The LAMR EA characterizes impacts as negligible, minor, moderate, and major, the definitions of which are specific to the resource being assessed (see the EA for details).[6]

2.5.1 Water Quality

Most research on the effects of PWC use on water quality focuses on the impacts of two-stroke engines and assumes that impacts caused by these engines also apply to the PWC powered by them. The conventional (i.e., carbureted) two-stroke PWC engine mixes air, gasoline, and oil in the combustion chamber; expels exhaust gases from the combustion chamber; and discharges as much as 30 percent of the unburned fuel mixture as part of the exhaust (California Air Resources Board, 1999). At common fuel consumption rates, an average 2-hour ride on a PWC may result in the discharge of 3 gallons (11.34 liters) of fuel into the water (VanMouwerik and Hagemann, 1999).

Contaminants released into the environment because of PWC use include those present in the raw fuel and those formed during combustion. Fuel used in PWC engines contains numerous hydrocarbon (HC) compounds, including volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX) and methyl tertiary butyl ether (MTBE). Unburned PWC fuel does not contain appreciable levels of polycyclic aromatic hydrocarbons (PAHs), but several PAHs are formed as a result of fuel combustion (i.e., phenanthrene, pyrene, chrysene/benzo(a)pyrene, and acenaphthylene) (VanMouwerik and Hagemann, 1999). Other HCs produced during incomplete combustion of PWC fuel include formaldehyde, acetaldehyde, diesel particulate matter (PM), and 1,3-butadiene (EPA, 1994).

[6]The EA assess the potential impacts of the three alternatives prior to the November 2002 PWC ban.

Unburned fuel and combustion by-products are released to the environment in PWC exhaust. Because of differences in chemical and physical characteristics, BTEX released into the water readily transfers from water to air, whereas most PAHs and MTBE do not. Therefore, water quality issues associated with BTEX in the water column are less critical than those associated with PAHs and MTBE (VanMouwerik and Hagemann, 1999).

Compounds released in water because of PWC use are known to adversely affect the health of humans and aquatic organisms. Exhaust emissions from two-stroke engines have been specifically shown to cause toxicological effects in fish (Tjarnlund et al., 1995; Oris et al., 1998). Sunlight can further increase the toxic effect of PAHs to aquatic organisms (Mekenyan et al., 1994; Arfsten, et al., 1996). Research evaluating the possible phototoxic effects of some PAHs to aquatic organisms has demonstrated that toxicity may vary as a result of a number of factors including length of exposure; turbidity, humic acid, and organic carbon levels; the location of the organism relative to the water or sediment surface; and weather/PAH fate issues (NCER, 1999). For instance, increased turbidity or organic carbon tended to reduce toxicity, and proximity to the surface might increase toxicity (i.e., shallow waters).

New PWC engines, including direct-injected two-stroke engines and four-stroke engines, decrease the amount of unburned fuel that escapes with PWC exhaust, and their use will result in decreased emissions (VanMouwerik and Hagemann, 1999). As discussed in Section 2.2.4, EPA's 1996 Marine Engine Rule is expected to result in a 50 percent reduction of current HC emissions from SI engines by 2020 and a 75 percent reduction in HC emissions by 2025 (*Federal Register*, 1996).

Baseline Water Quality Conditions at LAMR

Designated uses for Lake Meredith, as defined by the Texas Surface Water Quality Standards, are contact recreation, exceptional aquatic life, and public water supply. Water quality in Lake Meredith has been monitored by the Texas Natural Resources Conservation Commission (TNRCC), U.S. Geological Survey (USGS), and the Canadian River Municipal Water Authority (CRMWA). Among these three organizations, there are more than 29 water quality monitoring stations within the vicinity of Lake Meredith. Based on monitoring results, water quality in Lake

Meredith is generally considered very good, although elevated dissolved solids and chloride levels are of concern (NPS, 2003). NPS (2003) reports finding only one set of results for organic contaminants in water for Lake Meredith. The July 1999 analyses included benzene, xylene, ethylbenzene, and MTBE, all of which were below detection level of 0.2 ug/L.[7]

Because PWC are currently banned from LAMR, they have no impact on water quality.

Overall, the impact of PWC use on water quality at LAMR appears to be limited.

Potential Impact of PWC Use on Water Quality Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. Overall, the historical impact of PWC use on water quality at LAMR appears to be limited probably because of several factors, including the small number of PWC relative to other watercraft, the short length of the PWC use season, and the fact that water quality is affected by stressors other than PWC. As indicated above, organic contaminants have not been detected in Lake Meredith. Based on modeling results, NPS concluded that PWC use as managed through November 2002 would result in pollutant loads well below ecotoxicological and human health benchmarks, and thus that impacts would be negligible (NPS, 2003). NPS concludes that Alternative A would not result in the impairment of water resources.

In addition, any impacts to water quality from motorized vessels in general are expected to lessen as manufacturers meet EPA requirements to improve engine efficiency by 2006 and conventional engines are replaced with direct-injected two-stroke or four-stroke models.

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. Impacts to water quality from Alternative B are expected to be similar to Alternative A, although NPS anticipates beneficial impacts from the additional management restrictions (NPS, 2003). Prohibiting refueling while on

[7]The Texas Surface Water Quality Standards do not include aquatic life standards for typical gasoline. The lowest Texas human health standard for benzene is 5 ug/L (NPS, 2003).

the shoreline or out on the water, except in the marina, should minimize accidental fuel spills and thus incidental pollution of the lake relative to Alternative A.

Alternative C: No-Action (Continue PWC Ban). No impacts to water quality from PWC would occur within LAMR if the ban continued.

2.5.2 Air Quality

Air quality and visibility can be affected by emissions from two-stroke engines such as PWC motors. Emissions from PWC in national parks are one of many potential (albeit, relatively small) sources of these air quality and visibility impairments.

Up to one-third of the fuel delivered to conventional two-stroke engines goes unburned and is discharged as gaseous HCs.

Recreational marine engines, including PWC and outboard motors, contribute approximately 30 percent of national nonroad engine emissions and are the second-largest source of nonroad engine HC emissions nationally (*Federal Register*, 1996). According to the results of a 1990 inventory of emissions in California, watercraft engines were estimated to account for 141 tons of smog-forming reactive organic gases (ROG) 1,063 tons of carbon monoxide (CO), and 31 tons of nitrogen oxides (NO_x) emitted per day (Kado et al., 2000). A study comparing emissions from conventional and direct-injected two-stroke engines with four-stroke engines found that the new four-stroke engine has considerably lower emissions of PM, PAHs, and genotoxic activity (Kado et al., 2000). Based on a comparison with a typical 90-horsepower engine, it is estimated the ban of conventional two-stroke engines would result in a four-fold decrease in smog-forming pollution per engine (VanMouwerik and Hagemann, 1999).

Although PWC engine exhaust is usually routed below the waterline, a portion of the exhaust gases is released to the air and may affect air quality. Up to one-third of the fuel delivered to conventional two-stroke engines goes unburned and is discharged as gaseous HCs; the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as HCs (including VOCs [e.g., BTEX, and MTBE] and PAHs), NO_x, PM, and CO (Kado et al., 2000). PWC also contribute to the formation of ozone (O_3) in the atmosphere, which is formed when HCs react with NO_x in the presence of

sunlight (EPA, 1993). (See Section 2.5.1 for further discussion of burned and unburned constituents of PWC emissions.)

These compounds are known to adversely affect the health of both human and plant life. They may adversely affect park visitor and employee health, as well as sensitive park resources. Ozone causes respiratory problems in humans, including cough, airway irritation, and chest pain during inhalation. Ozone is also toxic to sensitive species of vegetation. It causes visible foliar injury, decreases plant growth, and increases plant susceptibility to insects and disease (EPA, 1993).

CO can interfere with the oxygen-carrying capacity of blood, resulting in lack of oxygen to tissues. NO_x and PM emissions associated with PWC use can degrade visibility. Adverse health effects also have been associated with airborne PM, especially PM less than 10 μm aerodynamic diameter (PM10) (Kado et al., 2000). NO_x also contributes to acid deposition effects on plants, water, and soil.

Baseline Air Quality Conditions at LAMR

Several industries within a 30-mile radius of LAMR potentially contribute to air pollution in the area. These facilities include two power plants (one coal and one natural gas), a nuclear weapons manufacturing plant, a copper refining and smelting plant, a nitrogen fertilizer plant, carbon black plants, and several slaughterhouses and feed lots. In addition, the more than 250 oil and gas wells within the LAMR boundaries may affect air quality. Although there are no air quality monitoring stations in or near LAMR, no exceedances of PM have been observed at the Amarillo site. Air quality in the region is generally considered good and in attainment with all national ambient air quality standards (NPS, 2003).

Currently there is no impact to air quality from PWC operating within LAMR because they are banned from the park.

Potential Impact of PWC Use on Air Quality Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. NPS anticipates that

air quality and air quality-related values would not be impaired under Alternative A. Based on estimates of annual emissions, NPS anticipates that Alternative A would result in minor negligible human health impacts from CO emissions based on 2001 use levels, and that emissions from PM, VOCs, and NO_X would have negligible impacts on human health.[8] Although PWC use under Alternative A would have no perceptible visibility impacts from PM, modeling results suggest that there may be minor impacts from ozone exposure (NPS, 2003).

Finally, localized improvements in air quality from reduced HC emissions are likely to be gradual as manufacturers meet EPA requirements to improve the engine efficiency by the year 2006 and conventional engines are replaced with direct-injected two-stroke or four-stroke models.

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. NPS anticipates that air quality and air quality-related values would not be impaired under Alternative B. Impacts are expected to be similar to Alternative A, although estimated emission loads are estimated to be slightly lower (NPS, 2003). Furthermore, prohibiting on-water and on-shore refueling of PWC could reduce accidental fuel spills and thus air pollution from volatile compounds in fuel relative to Alternative A.

Alternative C: No-Action (Continue PWC Ban). No impacts to air quality or related values from PWC would occur within LAMR if the ban continued.

2.5.3 Soundscape

PWC emit up to 105 dB per unit at 82 feet, which may disturb park visitors. NPS has established a noise limit of 82 dB at 82 feet. Noise from PWC may be more disturbing than noise from a constant source at 90 dB due to rapid changes in acceleration and direction of noise (EPA, 1974) and their ability to be driven in shallow water close to the shoreline. However, the newer, EPA 2006 compliant

[8]NPS defined minor impacts as emissions less than 100 tons per year, and negligible impacts as emission less than 50 tons per year.

models of PWC may be up to 50 to 70 percent quieter than the older models (PWIA, 2002).

Baseline Soundscape Conditions at LAMR

Natural sounds generally include sounds such as wind through trees and calling birds, while natural quiet includes the sounds associated with still nights. "Noise" is defined as unwanted sound that interferes with an activity or disturbs the person hearing it.

One aspect of experiencing LAMR's resources is the ability to hear the sounds associated with its natural resources, often referred to as "natural sounds" or "natural quiet." Natural sounds generally include sounds such as wind through trees and calling birds, while natural quiet includes the sounds associated with still nights. "Noise" is defined as unwanted sound that interferes with an activity or disturbs the person hearing it.

NPS reports that although the reservoir area of Lake Meredith is not known for its natural quiet, numerous natural quiet areas exist within the recreation area (NPS, 2003). Winds are nearly constant at LAMR and produce background noise. Other noise sources at LAMR include aircraft, recreational activities (large boats and speed boats generate the most lake noise), highway traffic, and noise associated with oil and natural gas production and transport. A study at LAMR showed that background noise levels (in the summer months) typically ranged between 34 and 50 dBA (Foch, 2000 as reported in NPS, 2003). PWC are currently banned from the park and therefore have no impact on the natural soundscape of LAMR.

Potential Impact of PWC Use on Soundscape Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. NPS anticipates that Alternative A would not result in the impairment of the natural soundscape of LAMR (NPS, 2003). NPS expects that PWC would have negligible impacts in most locations; they may cause minor to moderate impacts in the canyons in the northern portion of the lake or in backcountry locations. Over the long term, watercraft noise levels are expected to decline as new engine technologies are phased in.

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. NPS anticipates that Alternative B would not result in the impairment of the natural soundscape of LAMR and that impacts would be similar to

Alternative A (NPS, 2003). No-wake zones in the lake arms would reduce noise impacts in the back coves relative to Alternative A.

Alternative C: No-Action (Continue PWC Ban). No impacts to the natural soundscape from PWC would occur within LAMR if the ban continued.

2.5.4 Wildlife and Wildlife Habitat

PWC may affect wildlife by interrupting normal activities, inducing alarm or flight responses, causing animals to avoid habitat, and potentially affecting reproductive success.

PWC may affect wildlife by interrupting normal activities, inducing alarm or flight responses, causing animals to avoid habitat, and potentially affecting reproductive success. These effects are believed to be caused by a combination of PWC speed, noise, and ability to access sensitive areas, especially in shallow water (WDNR, 2000). PWC potentially can access sensitive shorelines and disrupt riparian habitats critical to wildlife. When run in very shallow water, PWC can disturb the substrate, including aquatic plants, benthic invertebrates, and, at certain times of year, fish breeding and nursery areas. Furthermore, water quality degradation caused by PWC can affect migratory avian species in the area.

Waterfowl and nesting birds may be particularly sensitive to PWC because of their noise, speed, and unique ability to access shallow water. This may force nesting birds to abandon eggs during crucial embryo development stages, keep adults away from nestlings and thus prevent them from defending the nest against predators, and flush other waterfowl from habitat, causing stress and associated behavior changes (WDNR, 2000; Burger, 1998; Rodgers and Smith, 1997).

Baseline Wildlife and Wildlife Habitat Conditions at LAMR

There are currently no adverse impacts to wildlife populations from PWC because they are banned in the park. The ban also eliminates any potential impacts to wildlife resulting from PWC-associated noise or emissions.

Habitat. LAMR consists of nearly 47,000 acres of lake, canyonland, and prairie habitat. Lake Meredith, with a surface area of approximately 10,000 to 16,000 acres and 100 miles of shoreline, provides habitat for waterfowl, fish, and other animals. Numerous rivers and drainages branch off Lake Meredith and provide habitat, although these waters are largely ephemeral due to fluctuations in

rainfall, flow alteration by the Sanford Dam, and water extraction for surrounding industries and municipalities. Cottonwoods, soapberry, sandbar willow, and exotic plant species (such as salt cedar) grow in shallow creek beds. Lake Meredith is largely bordered by steep, rocky hillsides. Semi-arid plains habitat is found on mesa tops and hillsides, where prairie grasses, mesquite, prickly pear cactus, and yucca grow.

Lake Meredith is largely bordered by steep, rocky hillsides. Semi-arid plains habitat is found on mesa tops and hillsides, where prairie grasses, mesquite, prickly pear cactus, and yucca grow.

Mammals. Phillips (1989) estimates that 65 species of mammals occur in LAMR. These include larger predators such as black bear, mountain lions, bobcats, wolves, and coyotes, and herbivores such as white-tailed deer, mule deer, and pronghorn antelope. Twenty-eight species of rodents, eleven species of bats, three species of rabbits, three species of fox, weasels, ferrets, mink, badgers, river otters, and other mammals also are reportedly found in LAMR.

According to NPS (2002a), the major mammal species in LAMR include deer, coyotes, porcupines, raccoons, skunks, ground squirrels, rabbits, pocket gophers, moles, bats, rats, and mice. The most common mammal species in LAMR have habitats away from shoreline and can move away from the lake if disturbed by watercraft.

Birds. Because of the rich diversity of habitats within LAMR, an estimated 227 species of birds are found in the area (Phillips, 1989). Game birds include Wild Turkey, Mourning Dove, Bobwhite and Scaled Quail, Canada Geese, and several species of ducks. LAMR is located along the Central Flyway, and large numbers of ducks, geese, wading birds, and songbirds use the open water and wetland areas during spring and fall migration.

There is little information available on bird nesting activity in LAMR. Most waterfowl (ducks and geese) are thought to be transient, passing through LAMR during spring and fall and breeding elsewhere. Because of steep, rocky canyon walls bordering much of Lake Meredith, any geese, ducks, and shorebirds breeding near shore would be largely restricted to shallow creeks and wetland areas not easily accessed by watercraft. There is one known Great Blue Heron rookery in LAMR, located away from road or watercraft access (NPS, 2002a). Upland birds (e.g., quail) and songbirds nesting in LAMR would not likely be affected by lake recreational activities.

Fish. An estimated 29 species of fish are present in LAMR (Phillips, 1989). Predominant species include walleye (Lake Meredith is the primary lake in Texas for walleye fishing), smallmouth bass, white bass, white crappie, largemouth bass, channel catfish, flathead catfish, and carp. Currently, the largest threats to fish spawning habitat are low water levels and exotic plant invasion in canyon areas.

Amphibians and Reptiles. Eleven species of amphibians and 39 species of reptiles are reported in LAMR (Phillips, 1989).

Aquatic Invertebrates. LAMR has not yet been surveyed for aquatic invertebrates. Because of the algae observed near shore and the healthy fish populations in the lake, it is assumed that LAMR has habitat for and healthy populations of aquatic invertebrates.

Potential Impact of PWC Use on Wildlife Habitat Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. NPS anticipates no impairment of wildlife or wildlife habitat under Alternative A. There are no known adverse impacts associated with historical PWC use on wildlife in LAMR; specifically park staff have not observed PWC users harassing birds or other wildlife, and no PWC-wildlife collisions have occurred. In addition, few wildlife species use the open water areas of the lake where the majority of the high speed use occurs (NPS, 2003).

The low water levels in Lake Meredith make much of the recreation area inaccessible to PWC, which also reduces the areas of potential impact (NPS, 2003). Because PWC must travel at no-wake speed to access the shoreline (state boating requirement), any wildlife there would be able to move out of the way. As mentioned above, large numbers of birds pass through LAMR during spring and fall migration. The PWC season historically runs from mid-May until September; thus, there would be little overlap with the presence of migrating birds and limited opportunity for disturbance (e.g., by PWC noise) of migrating birds.

PWC use at LAMR is unlikely to disturb spawning fish. Walleye, crappie, and bass spawn in shallow areas off-limits to PWC and

boats. Moreover, as discussed in Section 2.5.1, PWC use under Alternative A is not expected to result in exceedances of ecotoxicological benchmarks; thus, there would likely be no or negligible impacts to fish or aquatic invertebrates.

Under Alternatives A and B, impacts on wildlife species and wildlife habitat are likely to be minimal because of the small amount of PWC use compared to other watercraft and the timing of the PWC season.

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. Like Alternative A, NPS anticipates no impairment of wildlife or wildlife habitat under Alternative B. Restricting PWC speed in canyons and prohibiting on-lake refueling would minimize any impacts in these areas relative to Alternative A, although these were identified as negligible.

Alternative C: No-Action (Continue PWC Ban). No impacts to the wildlife or wildlife habitat from PWC would occur within LAMR if the ban continued.

Current Conditions for Threatened, Endangered, and Special Concern Species

Nineteen federally or state-listed species have been documented or are likely to occur within LAMR or could occur in the area based on available habitat (NPS, 2003). However, only four species have been documented in the park: bald eagle, Arkansas River shiner, black-tailed prairie dog, and Texas horned lizard. Bald eagles are primarily winter residents of the park and, based on park staff reports, winter in the area in substantial numbers. There is no known summer nesting of bald eagles in the park. A colony of black-tailed prairie dogs (a candidate species for federal listing) in LAMR was eradicated in April 2001 by a natural outbreak of bubonic plague. Portions of the Canadian River and Coetas Creek within Lake Meredith have been designated as critical habitat for the Arkansas River shiner, a small minnow. However historical lake levels have never permitted recreational use in these areas. Finally, the Texas horned lizard could possibly occur along the upper edges of the more remote and less disturbed shoreline, but it is not likely to coincide with areas of historic PWC use (NPS, 2003).

Potential Impact of PWC Use on Threatened and Endangered Species under the Proposed Management Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. NPS anticipates no impairment of threatened and endangered species or designated critical habitats under Alternative A. Specifically, the identified species are either not present as permanent residents or do not have preferred or critical habitat in areas that would permit PWC use (NPS, 2003).

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. NPS anticipates no impairment of threatened and endangered species or designated critical habitats under Alternative B. Impacts would be the same as those described for Alternative A (NPS, 2003).

Alternative C: No Action (Continue PWC Ban). No impacts of threatened and endangered species from PWC would occur within LAMR if the ban continued.

2.5.5 Shorelines and Shoreline Vegetation

PWC use can potentially adversely affect the shoreline habitat including the shoreline, shoreline vegetation, and submerged aquatic vegetation (SAV) beds. Shoreline and shoreline vegetation is critical to the juvenile stages of fish and general overall habitat for a variety of aquatic organisms, including fish and shellfish, and waterfowl species. SAV beds are also critical to aquatic organisms. SAV beds reduce wave action, support nursery fish, provide protection from predators, stabilize sediment, and provide food for many species.

PWC can affect shoreline and shoreline vegetation because they are able to access areas where most other watercraft cannot go because of their shallow draft. As a result, PWC may land on the shoreline allowing visitors to access and disturb areas where sensitive plant species exist. In addition, wakes created by PWC may cause erosion and thus affect shorelines. Turbulence from boat propellers near the shoreline can also erode the shoreline by destabilizing the bottom (WDNR, 2000).

PWC use can also affect SAV by increasing turbidity, which may result in decreased sunlight available for SAV, limit vegetation growth, and ultimately decrease water quality. PWC use in shallow water supporting SAV may reduce its value as important habitat for animals by redistributing the plants and organisms that use these grasses for habitat.

Baseline Condition of Shorelines and Shoreline Vegetation at LAMR

No data are available on watercraft impacts on shorelines and shoreline vegetation in LAMR. Much of Lake Meredith is bordered by steep, rocky canyon walls, with little or no vegetation growing near the water. Streams and rivers feeding into the Canadian River may have more vegetation at shoreline, although the area is very sandy and saline, and some of the larger plant species tend to be exotic plants like Tamarisk. According to NPS staff, nearly constant winds are the primary contributor to shoreline erosion, and lake drawdown largely limits the establishment of SAV (see also NPS, 2003).

Potential Impact of PWC Use on Shoreline and Shoreline Vegetation Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. NPS anticipates no impairment of shoreline vegetation under Alternative A. PWC use is expected to have negligible impact, because no perceptible changes to plant community size, integrity, or continuity are likely under Alternative A (NPS, 2003).

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. NPS anticipates no impairment of shoreline vegetation under Alternative B. PWC use is expected to have negligible impact, because no perceptible changes to plant community size, integrity, or continuity are likely under Alternative A (NPS, 2003). Any benefits from restrictions on PWC speed (reduced erosion in side canyons) or refueling (less shoreline pollution) relative to Alternative A are likely to be negligible.

Alternative C: No-Action (Continue PWC Ban). No impacts to shoreline vegetation from PWC would occur within LAMR if the ban continued.

2.5.6 Cultural and Ethnographic Resources

Less than 20 percent of LAMR has been surveyed for archaeological or ethnographic sites.[9] More than 510 archaeological sites have been recorded within LAMR boundaries (NPS, 2002a). Forty-four prehistoric and eight historic archaeological sites were identified along the Lake Meredith shoreline as of 1981, according to NPS staff. Human American Indian remains have been found eroding from the shore of Lake Meredith.

Overall, there is no indication that PWC or PWC users specifically cause degradation of cultural or ethnographic resources at LAMR.

According to NPS officials, shoreline archaeological and ethnographic sites are most threatened by natural erosion due to fluctuating water levels, winds, and wind-driven waves. Shoreline erosion due to wave action from PWC and other boats is considered minor compared to effects of wind-driven waves.

Uncontrolled access to cultural sites remains a problem at LAMR. Watercraft, as well as motorists, ATV users, and hikers can access sites along and near the shoreline. Although there have been no reports in recent years of people taking artifacts from shoreline sites, NPS does not have enough staff to patrol all areas and enforce regulations.

Potential Impact of PWC Use on Cultural Resources Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed According to the Superintendent's Compendium Prior to November 2002 Under a Special Regulation. NPS anticipates no impairment of any archeological or submerged cultural resources under Alternative A (NPS, 2003). Historic use of PWC is believed to have had little impact on shoreline erosion or destruction of cultural or historic resources due to increased visitor access to these sites.

[9]NPS guidelines define an archaeological resource as "any material remains or physical evidence of past human life or activities which are of archaeological interest, including the record of the effects of human activities on the environment" (NPS, 2002d). NPS guidelines define an ethnographic resource as "a tangible aspect of a cultural system, past or present, that is identified as significant by a recognized ethnic group" (NPS-28 Cultural Resources Management Guidelines, Appendix A).

Finally, project-by-project inventories and mitigation would still be conducted.

Alternative B (Preferred Alternative): Reinstate PWC Use with Mitigation to Reduce User Conflicts in Lake Area and to Protect Water Resources Under a Special Regulation. NPS anticipates no impairment of any archeological or submerged cultural resources under Alternative B (NPS, 2003). Restrictions on PWC speed and refueling are unlikely to change impacts on cultural or ethnographic resources at LAMR.

Alternative C: No-Action (Continue PWC Ban). No impacts to cultural or ethnographic resources from PWC would occur within LAMR if the ban continued.

2.6 ECONOMIC ACTIVITY IN THE SURROUNDING COMMUNITIES

LAMR is located in a rural area in the panhandle of Texas. The closest towns to the lake are the small communities of Sanford and Fritch, whose economies are closely linked to LAMR visitation. Amarillo, with a population of 173,600, is located approximately 40 miles southwest of LAMR and is the largest city within 100 miles of the recreation area.

NPS identified 10 PWC-related businesses in the vicinity of LAMR that may be directly affected by any change in regulations on PWC use in the park.

The towns of Sanford and Fritch rely heavily on tourism as an important part of their economies. However, prior to the ban, PWC use in the preserve was not one of the primary forms of recreation in this area. NPS estimates that PWC users accounted for approximately 14,263 out of more than 1.2 million visitors to LAMR in 2001. PWC use in the recreation area prior to the ban is believed to have been mostly by residents of the Texas panhandle who used their own machines. NPS identified 10 PWC-related businesses in the vicinity of LAMR that may be affected by reinstating PWC use in LAMR, including PWC dealerships, a PWC rental shop, and convenience stores offering PWC storage and other boating-related services.

NPS contacted businesses in the communities surrounding LAMR to solicit input on the potential impacts of PWC regulations. Only one firm offered PWC rentals in LAMR prior to the ban. This firm is a large marina located directly on the lake, and the majority of its business is related to other types of motorized watercraft. No PWC

rentals were available at the marina in 2001, but three to four PWC were available for rent in 2002. If PWC use continued, this firm anticipates that the maximum number of PWC that could be available for rent in the near future is six.

Three firms that sell new PWC were identified in Amarillo, Texas. These three firms sell the majority of PWC in the area. However, two additional firms that sell used PWC were identified in the Amarillo area. All five of these firms have other sources of revenue, including motorcycle and ATV sales, boat sales and repair, and automotive repairs. Because LAMR is the largest destination for water-based recreation in the Texas panhandle region, allowing PWC use in LAMR will likely have a large impact on the PWC-related revenues of these firms. However, the diversity of their revenue sources is expected to have at least partially mitigated any negative impacts caused by the November 2002 ban on PWC use in LAMR.

Because PWC users account for a very small fraction of economic activity in the region, it is very unlikely that allowing PWC will have significant incremental impacts on the region's economy.

NPS also identified four stores in the immediate vicinity of LAMR that sell food, bait and tackle for fishermen, and general convenience items. These stores provided estimates of the percentage of establishment annual revenue that could be attributed to PWC users prior to the ban, ranging from 15 to 33 percent. This estimate is consistent with the estimated percentage of watercraft in LAMR that are PWC, but it is much higher than the estimated PWC users' share of total park visitation (1.14 percent). The stores contacted may have had a disproportionately large share of visitors that used PWC in LAMR prior to the ban, because these stores seem to focus primarily on watercraft users. Although the LAMR park officials interviewed indicated that their visitation estimates were uncertain, in the absence of additional information, it was assumed that LAMR staff have the best available information about PWC visitation in LAMR. Thus, impacts obtained using the park staff estimates are presented as the primary results. However, the effect of using visitation data implied by the local businesses is also discussed. In addition, NPS based the small business analyses (see Section 5) on the data provided by the individual small businesses potentially affected by reinstating PWC use in LAMR.

In addition to the businesses contacted, reinstating PWC use in LAMR could also affect lodging establishments, restaurants, gas stations, and other retail stores in the area. These establishments

may be affected if the proposed regulations lead to changes in visitation to the park and surrounding area. However, because PWC users prior to the ban accounted for a very small fraction of economic activity in the region, it is very unlikely that allowing PWC will have significant incremental impacts on the region's economy. The estimated regional economic impacts are discussed in more detail in Section 3.

3 Economic Impact Analysis of Alternatives for Managing PWC Use in Lake Meredith National Recreation Area

Regulations on PWC use in LAMR may affect the local economy in several ways, including changes in park visitation, sales and profits of local businesses, local employment, and local and state sales tax revenue. Generally, allowing PWC in the park is expected to increase economic activity in the areas surrounding the park. However, the incremental impacts are very small relative to the size of the local economy.

Historically, PWC use has been a relatively minor recreational activity in LAMR. In 2001, an estimated 1.14 percent of annual visitors used PWC in the park. Thus, although reinstating PWC use in LAMR could have a positive economic impact on the surrounding area, any impact is likely to be small. The primary economic impacts associated with Alternatives A and B are the potential increases in the sales, profits, and employment of PWC sales and rental shops, restaurants, and other businesses that serve PWC users visiting LAMR relative to baseline conditions (ban). The total impact of each alternative will depend in large part on the response of the affected individuals and firms to the ban on PWC use in LAMR. To the extent that affected local retailers were able to provide substitute products and services, they may have been able to reduce the negative impact on their profits associated with the November 2002 ban. In addition, some former PWC users may have continued to visit LAMR to participate in other recreational activities. It is also possible that visitation to LAMR by non-PWC users increased following the ban on PWC use if the restrictions made park visitation more enjoyable for this group of people. The more that producers and PWC users made adjustments to mitigate

the negative impacts of the ban, and the more that non-PWC users increased their visitation, the smaller the positive economic impacts of reinstating PWC use at LAMR.[1]

This section summarizes the incremental regional economic impacts associated with the proposed alternatives for managing PWC use in LAMR. The majority of the economic impacts are expected to be concentrated in the counties surrounding the park (Hutchinson, Moore, and Potter Counties). Thus, projected changes in economic activity are compared to the size of the county economies to place the impacts in perspective.

3.1 SCENARIOS EXAMINED IN THIS REPORT

NPS estimates that PWC users accounted for only about 1.14 percent of annual visitation in 2001.

As described in Section 2.2, PWC users accounted for a small fraction of total visitation to LAMR prior to the ban in November 2002. NPS estimates that 14,263 visitors used PWC in LAMR in 2001. Baseline visitation (i.e., with PWC being banned from LAMR) was projected through 2012 using a starting point of average annual visitation over 5 years, 1997 to 2001. NPS assumed that the proportion of visitors who used PWC in 2001 was representative of the 1997 to 2001 time period. Baseline visitation was then assumed to increase at a rate equal to the average of the 1990 to 2000 annual population growth rates in counties surrounding the park.[2]

PWC users are expected to change their visitation to LAMR in response to regulations placed on PWC use. To estimate the magnitude of the resulting economic impacts, NPS constructed scenarios for the regulatory alternatives based on the available information. For Alternative A, it is expected that PWC users who previously used PWC in the park would return because PWC use would be managed in the same way as before the 2002 ban. Under Alternative B, PWC users would be able to use their PWC in LAMR,

[1] A decrease in expenditures for substitute activities in the LAMR region in response to allowing PWC use would partially offset any positive regional impacts associated with Alternatives A and B. In addition, there may be reallocation of revenue among businesses.

[2] It would be preferable to use population projections rather than assuming that population growth would continue at historical levels. However, the Census Bureau only provides population projections at the state and national levels. Because most LAMR visitors come from an area covering parts of several states, NPS believes that the recent historical population growth rate in these areas is a more appropriate basis for projecting population than the projected growth rate for the state.

but would be forced to travel at no-wake speeds in the canyons and refueling of PWC at areas other than the marina would be prohibited. Thus, it is assumed that most former PWC users, but not all, will return to visit the LAMR region to use PWC. However, of those who do not, some will return to LAMR to enjoy other recreational activities or use PWC in nearby substitute areas. Under Alternative C, it is expected that there will be no change in visitation relative to baseline projections because management of PWC in LAMR would remain unchanged relative to current conditions.

It is assumed that people who resume visiting the LAMR area will have the same spending patterns as current visitors, except that some of them will resume renting PWC. It is possible that some visitors who currently engage in summer recreational activities other than PWC use would reallocate spending on those activities towards expenditures on PWC use. However, because there is no specific data available on spending by users engaging in different types of recreation, this potential spending change is not included in the analysis.

To better develop the economic impact scenarios, NPS interviewed PWC sales and rental shop owners identified in the area concerning the expected impacts on those businesses. The universe of affected entities was identified by visiting the LAMR area and contacting potentially affected businesses. In addition, NPS used secondary sources such as *InfoUSA* (2002) to help identify businesses in the region that may have revenues related to PWC use in LAMR. NPS identified 10 PWC-related businesses in the vicinity of LAMR that may be affected by any restriction on PWC use, including PWC dealerships, a PWC rental shop, and convenience stores offering PWC storage and other boating-related services. However, additional firms in the region may be directly affected by regulations on PWC use in LAMR.

NPS contacted businesses in the communities surrounding LAMR to solicit input on the potential impacts of PWC restrictions. There is only one firm that offered PWC rentals on LAMR. This firm is a large marina located directly on the lake, and the majority of its business is related to other types of motorized watercraft. No PWC rentals were offered by the marina in 2001, but three to four PWC were expected to be available for rent in 2002. The firm anticipates that if PWC are allowed to return to LAMR, six PWC will be the

maximum number that would be available for rent in the near future. Three firms that sell new PWC were identified in Amarillo, Texas. These three firms sell the majority of PWC in the area. However, two additional firms that sell used PWC were identified in the Amarillo area. All five of these firms have other sources of revenue, including motorcycle and ATV sales, boat sales and repair, and automotive repairs. Because LAMR is the largest destination for water-based recreation in the Texas panhandle region, reinstating PWC use in LAMR will likely have a large impact on the PWC-related revenues of these firms. However, these firms have other sources of revenue that make up the majority of their sales.

NPS also identified four stores in the immediate vicinity of LAMR that sell food, bait and tackle for fishermen, and general convenience items. These stores estimated that prior to the ban, PWC users accounted for 15 to 33 percent of store revenues. This estimate is consistent with the estimated percentage of watercraft in LAMR that are PWC, but it is much higher than the estimated PWC users' share of total park visitation (1.14 percent). The stores contacted may have had a disproportionately large share of visitors that use PWC, because they seem to focus primarily on watercraft users. Although the LAMR park officials interviewed indicated that their visitation estimates were uncertain, in the absence of additional information, it was assumed that LAMR staff have the best available information about PWC visitation in LAMR. For the analysis of the impact of the alternatives on convenience store revenues, NPS estimates that approximately 15 percent of the revenues for these firms were from purchases by PWC users who visited LAMR prior to the ban.[3]

NPS used information from these interviews to help estimate baseline revenues for firms deriving revenue from PWC use in LAMR. In some cases, NPS used estimates of business revenues from *InfoUSA*. However, these data are only provided in ranges. NPS used the midpoint of this range for the analysis, which may understate or overstate the actual revenue of a particular business.

[3]This assumption was made based on conversations with the potentially affected businesses and park officials, which, as noted in Section 2.6, offer conflicting estimates of the proportion of visitors to the area that were PWC users prior to the ban on PWC.

Based on information collected from local businesses and LAMR park staff, scenarios were developed for each of the proposed regulatory alternatives. The three primary scenarios analyzed for LAMR are summarized in Table 3-1. For Alternatives A and B, NPS assumed that PWC use would remain constant in future years.

Table 3-1. Assumptions Used in Analyzing Economic Impacts of LAMR Regulatory Alternatives (%)

	Alternative A	Alternative B	Alternative C
Annual percentage change in the number of visitors using PWC in LAMR that would have occurred in the absence of the ban[a]	0%	0%	0%
Baseline annual percentage change in non-PWC user visitation to LAMR[b]	1.05%	1.05%	1.05%
Percentage of visitors reducing PWC use in LAMR due to ban that will continue to visit for other activities[c]	80%	80%	80%
Percentage of visitors using PWC in LAMR prior to ban that will resume using PWC in LAMR if PWC use is authorized[c]	100%	95%	NA
Percentage of visitors renting PWC for use in LAMR prior to ban that will resume renting PWC for use in LAMR[c]	100%	95%	NA
Percentage of visitors purchasing PWC for use in LAMR prior to ban that will resume purchasing PWC for use in LAMR[c]	100%	95%	NA

NA = not applicable

[a]Based on estimates provided by LAMR staff (NPS, 2003).

[b]Based on regional population growth from 1990 to 2000 (U.S. Census Bureau, 2002).

[c]NPS estimates.

As discussed in Section 2.2, the assumption that PWC use in the future would remain constant is based on observations by LAMR staff. It is assumed here that park staff have the best information available for predicting future PWC use in LAMR, despite data from PWC registrations indicating a decline in the number of PWC registered both in the panhandle of Texas and statewide.

For visitors who do not use PWC, visitation to the park was assumed to be increasing at an annual rate equal to the average annual population growth rate over the last decade for the counties surrounding LAMR (see Section 2.2.3). That growth rate was 1.05

percent, which is above the national growth rate of 0.9 percent over that time period (Census Bureau, 2002).

It was assumed that PWC visitation to LAMR would increase to pre-ban levels under Alternative A, increase to 95 percent of pre-ban levels under Alternative B, and remain at baseline levels under Alternative C.

It was assumed that PWC visitation to LAMR would return to pre-ban levels under Alternative A and to 95 percent of pre-ban levels under Alternative B and remain zero under Alternative C. Accordingly, PWC sales revenues, PWC rental and storage revenues, and convenience store revenues from PWC users are all assumed to return to pre-ban levels under Alternative A and 95 percent of pre-ban levels under Alternative B. Under Alternative C, it is expected that there will be no change in PWC sales or rental revenues relative to baseline projections because PWC would continue to be banned in LAMR. It should be noted that, under the baseline projections, in which PWC are banned from LAMR, park-related PWC rentals were assumed to have declined by 100 percent relative to pre-ban levels and PWC sales are assumed to have declined by 75 percent relative to pre-ban levels.[4]

As described in Section 2.2.3, baseline visitation beginning in 2003 was estimated by assuming that 80 percent of those visitors who previously used PWC in LAMR but were forced to stop because of the November 2002 ban would continue to visit the park to engage in alternative activities. This assumption is based on the fact that LAMR is a unique recreational destination in the region and that there are few substitutes in the Texas panhandle for water-based recreation.

To project PWC use from 2003 through 2012 for the alternatives where PWC would be permitted in the park (Alternatives A and B), NPS assumed that PWC use would remain constant in the future. As discussed in Section 2, this assumption is at odds with local PWC registration trends. In addition, as shown in Table 3-2, nationwide sales of new PWC have been declining dramatically since 1995 (NMMA, 2002). However, it is certainly possible that regional PWC use differs from national trends. Based on input from park staff, NPS assumed that PWC use would remain constant in the future.

[4]PWC sales were not assumed to have fallen by 100 percent because it is expected that some area residents would have continued to purchase PWC at these dealerships to use in alternative locations.

Table 3-2. National PWC Sales, 1991–2001 (Number of PWC)

Year	PWC Sales
1991	68,000
1992	79,000
1993	107,000
1994	142,000
1995	200,000
1996	191,000
1997	176,000
1998	130,000
1999	106,000
2000	92,000
2001	83,000

Source: National Marine Manufacturers Association (NMMA). 2002. "Annual Retail Unit sales Estimates." *Boating 2001.* National Marine Manufacturers Association. <www.nmma.org>. As obtained July 11, 2002.

Table 3-3 presents the projected incremental visitation associated with the alternatives for PWC management in LAMR using the assumptions summarized above and in Table 3-1. Alternatives A and B both increase total visitation because they eliminate the ban on PWC use in LAMR, leading to a net increase in visitation by people who used PWC in LAMR prior to the November 2002 ban.[5] The increase in PWC users in the park shown in Table 3-3 reflects those visitors that used PWC in LAMR prior to the ban who resume PWC use under Alternatives A and B. The decrease in non-PWC visitation by former PWC users under these alternatives reflects those former PWC users who had continued to visit the park to engage in alternative activities but will now resume PWC use instead. There is no change in visitation relative to baseline conditions expected under Alternative C because this alternative maintains the ban on PWC use in LAMR. The incremental visitation by visitors using PWC in the park remains constant over time because it is assumed that PWC use levels in LAMR will be constant over time as described earlier.

[5]Visitation by non-PWC users who were not former PWC users may decline if PWC use were reauthorized. However, the impact of this possible reduction has not been quantified because of a lack of data.

Table 3-3. Incremental LAMR Visitation Under Regulation Relative to Baseline Conditions[a]

	Alternative A			Alternative B			Alternative C[b]		
Year	Former PWC Users that Resume PWC Use[c]	Non-PWC Users[d]	Total Visitation	Former PWC Users that Resume PWC Use[c]	Non-PWC Users[d]	Total Visitation	Former PWC Users that Resume PWC Use[c]	Non-PWC Users[d]	Total Visitation
2003	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2004	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2005	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2006	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2007	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2008	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2009	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2010	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2011	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—
2012	18,197	–14,558	3,639	17,287	–14,558	2,730	—	—	—

[a]NPS generated these estimates using the assumptions in Table 3-1.

[b]NPS assumed that there would be no change in visitation relative to baseline conditions under Alternative C because this alternative maintains baseline PWC management (ban on PWC use in LAMR).

[c]This column includes those visitors that used PWC in the park prior to the November 2002 ban who would resume use if PWC use were reauthorized. It includes both former PWC users who were assumed to visit the park for other activities during the ban (who are recategorized from non-PWC users to PWC users in this table) and former PWC users who were assumed to stop visiting the park if they cannot use PWC (their return to visiting the park leads to a net increase in visitation relative to baseline for Alternatives A and B).

[d]These are the former PWC users who were assumed to continue to visit the park to engage in alternative activities under baseline conditions. If PWC use is authorized, these visitors are expected to resume using PWC in the park and are counted as PWC users rather than non-PWC users in the table. Without this adjustment, these visitors would be counted twice.

3.2 IMPACT OF PWC REGULATIONS ON LOCAL ECONOMIES

The proposed regulations may affect the local economy in several ways, including changes in park visitation, sales and profits of local businesses, local employment, and local and state sales tax revenue. Generally, reinstating PWC use in LAMR is expected to increase economic activity slightly in the areas surrounding the park relative to baseline conditions. The following sections describe the estimated economic impacts on the region where the majority of the effects from increased visitation to LAMR will be felt.

3.2.1 Effect of Regulation on Visitation to LAMR Area

Generally, reinstating the use of PWC in LAMR is expected to increase economic activity slightly in the areas surrounding the park.

Alternatives A and B are expected to lead to an increase in the number of visitor-days spent in LAMR compared with the projected baseline, as shown in Table 3-3. This anticipated increase in the number of visitor-days is primarily due to the expectation that some people who used PWC in the park prior to the ban will increase their visitation to LAMR relative to the baseline if PWC use is permitted. The actual increase in park visitation depends on several factors. Some people who previously used PWC in LAMR may have chosen to continue visiting the park after the ban on PWC use to enjoy alternative summer activities available within LAMR, such as hiking, boating, and fishing. As mentioned earlier, visitation by non-PWC users may have increased as a result of the ban on PWC use because the absence of PWC may have created a more enjoyable outdoor experience for some members of this group. This increased visitation could partially offset the loss in PWC users but was not quantified in this report because of a lack of data. Consequently, to the extent that non-PWC users increased their visitation to the park as a result of the ban on PWC use, the results of this analysis may have overestimated the change in visitation resulting from regulations that allow PWC to return to LAMR.

3.2.2 Effect of Regulation on Local Business Output

As a result of the incremental increases in visitation to the LAMR area expected under Alternatives A and B, there will be a corresponding increase in the value of local business output. The primary sectors that are affected by an increase in summer visitation are the tourism sectors, including PWC sales and rental shops, restaurants, and retailers. As discussed in Appendix A, although the

direct impact of an increase in visitor spending is primarily felt in these sectors, many additional sectors of the economy will be affected to some extent through secondary impacts. NPS focuses on the impacts for 2003, the first year after implementation of the selected alternative for PWC management.

Impacts in subsequent years will be similar, because PWC visitation is expected to remain constant after 2003 (see Table 3-3). The impact in all years is expected to be very small relative to the size of the local economy.

NPS used information from local businesses on the reduction in revenues that they anticipated from the November 2002 ban on PWC use in LAMR to estimate the increase in revenues that would occur under alternatives that do not include a ban.

To estimate spending impacts, it is necessary to obtain spending information for use with this study's estimated changes in visitation. No secondary data are available concerning the reduction in the number of PWC rented, sold, and serviced annually that resulted from the November 2002 ban on PWC in LAMR. Thus, NPS used information provided by local businesses on pre-ban PWC-related revenues and the estimated reductions in PWC sales and rentals that resulted from the ban to project the total increase in revenue for these categories that would occur under Alternatives A and B, which allow PWC to return to LAMR (i.e., assuming that PWC-related revenues would approach or reach pre-ban levels).

For categories of tourism spending other than direct spending on PWC, spending profiles were used in conjunction with estimated changes in visitation to determine the total change in park-related expenditures. The Money Generation Model (MGM2) is a simple input-output (I-O) model that NPS often uses to estimate local economic impacts associated with national park visitation. It provides generic spending profiles for national parks (see Appendix A and the MGM2 website <http://www.msu.edu/user/stynes/npsmgm/> for more information about economic impact analysis using I-O models).

Based on information collected from LAMR staff, almost all visits to the park are day trips. LAMR staff also estimated that about two-thirds of visitors are local and the remainder are nonlocal. Table 3-4 provides the spending information available from MGM2 for these two visitor-type categories to show the range of spending values estimated within this category. Only categories with positive average expenditures for a given visitor category are included in the

Table 3-4. Generic Spending Profiles for Visitors on Day Trips to National Parks (2001$)[a]

	Spending per Party		
	Low	**Medium**	**High**
Local Day User			
Restaurants and bars	$8.64	$12.35	$16.05
Groceries/take-out	$4.33	$6.19	$8.04
Gas and oil	$3.37	$4.82	$6.27
Other vehicle expenses	$0.36	$0.52	$0.67
Admissions and fees	$2.94	$4.21	$5.47
Clothing	$0.69	$0.98	$1.28
Sporting goods	$0.70	$1.00	$1.29
Souvenirs and other expenses	$4.68	$6.68	$8.69
Total	**$25.72**	**$36.74**	**$47.76**
Nonlocal Day User			
Restaurants and bars	$11.52	$16.46	$21.40
Groceries/take-out	$4.33	$6.19	$8.04
Gas and oil	$6.75	$9.64	$12.53
Other vehicle expenses	$0.54	$0.78	$1.01
Local transportation	$0.18	$0.26	$0.33
Admissions and fees	$5.15	$7.36	$9.57
Clothing	$1.38	$1.96	$2.55
Sporting goods	$0.70	$1.00	$1.29
Souvenirs and other expenses	$6.48	$9.26	$12.03
Total	**$37.03**	**$52.90**	**$68.77**

[a] These values are based on the average expenditures per party for visitors to national parks. However, the number of people per party assumed by MGM2 may differ between visitor segments.

Source: Money Generation Model—Version 2 (MGM2). 2002. <http://www.msu.edu/user/stynes/npsmgm/>. As obtained July 2002.

table under that category. For this analysis, the medium[6] estimate was used for all of the spending categories analyzed. Because there is no spending category included that represents boat rentals, purchases, or service, it was assumed that the spending estimates from MGM2 are in addition to spending on PWC rentals, sales, and service related to LAMR.

The MGM2 model assumes different party sizes, average lengths of stay, and number of entries into the park for the various visitor groups based on data gathered from several national parks.[7] The spending profile estimates in Table 3-4 were used in conjunction with the estimates of visitation changes presented in Table 3-3 to calculate the direct impacts of each alternative on business revenues presented in Table 3-5.[8]

For Alternative A, PWC rental revenues are estimated to increase by $237,500 relative to the baseline estimate. PWC sales and service revenues are expected to increase by $2.11 million.[9] Under Alternative B, NPS estimated that PWC rental revenues would increase by $225,630 and PWC sales and service revenues by $1.97 million, relative to the baseline.[10] Alternative C is expected to have no incremental impact on business revenues because it maintains baseline conditions.

As shown in Table 3-5, the largest direct impact is on establishments offering PWC sales and/or service, which accounts for about 88 percent of the estimated revenue increases resulting from allowing PWC to return to LAMR. The increase in PWC sales and service revenues is followed by PWC rental revenues; restaurants and bars; souvenirs and other retail; gas and oil;

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[6]MGM2 provides spending estimates that they classify as low, medium, and high expenditures.

[7]The model adjusts for multiple entries into the park to avoid counting expenditures for a single party more than once.

[8]Because MGM2 uses different assumptions for group size and multiple entries for each user category, it is not possible to use a constant party size and multiply the spending per party estimates presented in Table 3-4 by the expected changes in visitation in Table 3-3 to get the revenue impacts presented in Table 3-5.

[9]Assuming 50 percent of these revenues are made up by service and 50 percent by new machines, this would represent the purchase of approximately 135 new PWC at $7,800 each.

[10]Estimated impacts on PWC rentals, sales, and service were derived from interview data collected from local firms.

Table 3-5. First Year Direct Impact of PWC Regulations on Business Revenues in LAMR Region Relative to Baseline (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
PWC rentals/storage and other PWC revenues	$237,500	$225,630	$0
PWC sales/service	$2,114,120	$1,973,180	$0
Restaurants and bars	$19,950	$14,960	$0
Groceries/take-out	$9,000	$6,750	$0
Gas and oil	$9,330	$7,000	$0
Other vehicle expenses	$880	$660	$0
Local transportation	$120	$90	$0
Admissions and fees	$7,640	$5,730	$0
Clothing	$1,900	$1,430	$0
Sporting goods	$1,450	$1,090	$0
Souvenirs and other retail	$10,970	$8,230	$0
Total	$2,412,860	$2,244,750	$0

[a]All impacts were rounded to the nearest $10. Columns may not sum to totals due to rounding.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

groceries/take-out; admissions and fees; clothing; sporting goods; other vehicle expenses; and local transportation.

Note that the estimated increases in revenue in Table 3-5 overstate the true direct impact to the region because part of the sales value in the groceries/take-out, gas and oil, clothing, sporting goods, and souvenirs/retail categories goes to individuals and firms outside of the region and thus cannot be considered a gain to the LAMR region. Using these changes in revenues as inputs into MGM2, NPS estimated the total regional impacts on output. As discussed in Appendix A, for the retail sector only the retail markup can be included as an increase in regional output for the local area. This explains why the direct effect on the region estimated by MGM2 (reported in Table 3-6) is smaller than the change in revenues provided as input. In particular, because the majority of the revenue reductions occur in PWC sales and only the change of the retail markup is considered to affect regional output, the change in regional output is less than the change in revenue.

Table 3-6. First-Year Total Impacts on Value of Output for LAMR Region (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
Direct effect	$1,163,600	$1,081,800	$0
Total impact	$1,624,480	$1,510,290	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

The impacts of PWC regulation in LAMR on regional output are estimated to be approximately 0.04 percent of local personal income under the alternative with the largest positive impacts.

In addition to the direct effect of the regulation on the regional economy, the indirect and induced effects (ripple effects on input suppliers and from changes in household income, respectively) are estimated (see Appendix A). The multipliers used for this analysis are those provided in MGM2 for a typical small metropolitan area. Table 3-6 also summarizes the first-year total impacts on the value of output for businesses in the LAMR region. In this case, the multiplier effects are moderate. The total impact is about 40 percent larger than the direct effect for both alternatives. The total impact estimated for the three alternatives varies from $0 to $1.62 million, depending on the alternative chosen for managing PWC use. The level of personal income in Hutchinson, Moore, and Potter Counties was about $3.75 billion in 2000 (BEA, 2002). Thus, the impact on regional output of allowing PWC use in LAMR is estimated to be approximately 0.04 percent of local personal income under the alternative with the most positive impact (Alternative A).

3.2.3 Change in Value Added

Another measure of the impact on the local economy is the change in value added due to the regulation. Value added is the dollar value contributed to a product at each stage of its production. It is calculated at each stage by subtracting the costs of intermediate goods from the value of the final good to avoid double-counting the value of intermediate goods. It will be a smaller value than output because it excludes the value of intermediate goods, whereas output measures do not exclude all intermediate goods. The output measure only excludes the cost of goods produced in other regions resold by wholesalers or retailers. To calculate these values for LAMR, the MGM2 data for value added as a share of total output in each sector were applied to the estimated changes in local output

presented in Table 3-6 to get the direct effect on value added by sector. The MGM2 multiplier for value added in each sector was then applied to estimate the total impact. Table 3-7 provides the total change in value added for the local region as a result of the proposed regulations.

Table 3-7. First-Year Total Impacts on Value Added for LAMR Region (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
Direct effect	$576,770	$536,220	$0
Total impact	$1,146,720	$1,067,290	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.4 Effect on Personal Income

Personal income is a portion of value added that policy makers are commonly interested in. It comprises employee compensation and proprietor income. Table 3-8 shows how labor income in the LAMR region changes as a result of the proposed PWC regulations. This value is smaller than value added because it includes only a subset of the components of value added, but it is often useful to break value added down in this way to estimate the effect on regional personal income. Similar to value added, the direct effect of this component is calculated using the MGM2 data for personal income as a share of output in each sector. The total effect is then calculated by multiplying the direct effect by the personal income multiplier included in MGM2 for each sector.

Table 3-8. First-Year Total Impacts on Personal Income for LAMR Region (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
Direct effect	$379,530	$352,850	$0
Total impact	$745,310	$694,260	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.5 Change in Employment

Another potential effect of the alternatives for PWC use in LAMR is to increase employment in the sectors affected by the rules. These changes are calculated by MGM2 based on ratios of sales to employment for the affected industries in the LAMR area. As a result of the increase in sales anticipated under this regulation, companies may need more employees. The estimated increase in employment ranges from 0 to 40 employees, depending on the management alternative. These values are calculated based on MGM2 data on the number of employees per million dollars of output in each industry. Estimated changes in the number of employees are therefore equal to the change in output times the number of employees required per unit of output. Table 3-9 summarizes the results of the employment analysis.

Table 3-9. First-Year Total Change in Employment for LAMR Region (number of jobs)[a]

	Alternative A	Alternative B	Alternative C[b]
Direct effect	33.0	30.7	0.0
Total impact	40.3	37.5	0.0

[a]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[b]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.6 Change in Tax Revenue

In addition to impacts on the local businesses operating near LAMR, there is also an impact on the state and local governments. There is no state income tax in Texas. However, Texas has a 6.25 percent sales tax. In addition, local governments have the option to charge up to 2 percent sales tax in addition to the state tax. Different portions of the local area surrounding LAMR have different tax rates (primarily either 1 percent or 2 percent). For the analysis here, NPS assumed all local governments receive funds from a 2 percent local option sales tax. State sales tax revenues from affected businesses are estimated to increase by between $0 and $150,800 in the three scenarios analyzed, as presented in Table 3-10, based on estimated changes in business revenue. Local sales taxes are estimated to increase by $0 to $48,260.

Table 3-10. First-Year Change in State and Local Sales Tax Revenue[a,b]

	Alternative A	Alternative B	Alternative C[c]
State			
Income tax	$0	$0	$0
Sales tax	$150,800	$140,300	$0
Local			
Income tax	$0	$0	$0
Sales tax	$48,260	$44,890	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.7 Summary

NPS estimates that the total impact of the proposed alternatives for managing PWC use in LAMR on regional output is $1.62 million, $1.51 million, and $0 for Alternatives A, B, and C, respectively. These increases are very small compared to the size of the regional economy, even under Alternative A.

Several different measures of the economic impacts resulting from alternatives for managing PWC use in LAMR are presented in this section. Each measure provides slightly different information about the expected economic effects on the region. Income and value added are generally considered the best measures of economic impacts because sales and job estimates can be misleading. Sales or output measures include spending on inputs purchased outside the region, and job estimates are distorted by part-time and seasonal positions because the data available are on jobs, not on full-time equivalents. In addition, the wage rates across different jobs vary widely across industries (Stynes, 2000). Income and value-added measures both avoid these difficulties and concentrate on changes that affect only the LAMR region.

In the analysis presented here, NPS estimates that the total impact of the proposed alternatives for managing PWC use in LAMR on regional output is $1.62 million, $1.51 million, and $0 for Alternatives A, B, and C, respectively, in the first year after implementing the rule (see Table 3-6). These increases are very small compared to the size of the regional economy, even under Alternative A, which has the largest impacts. In 2000, total personal income in Hutchinson, Moore, and Potter Counties, where LAMR is located, was approximately $3.75 billion (Bureau of Economic Analysis, 2002). Thus, even if all revenues related to PWC use in LAMR were to reappear in the regional economy, the positive impact would be very small (regional output increases by about

0.04 percent of personal income), although businesses and communities in the county that rely heavily on PWC users may experience larger localized impacts.

3.2.8 Uncertainty

A number of factors will affect the regional economic impacts associated with the proposed alternatives. The 1996 EPA Marine Engine Rule, enacted by EPA in 1996, may have an impact on PWC use nationally and in LAMR. As described in Section 2.2.4, this rule requires PWC (and other SI marine engine) manufacturers to reduce emissions by 75 percent from the 1998 model year until the 2006 model year (*Federal Register*, 1996). EPA regulations phasing in emissions reductions from new PWC over the period from 1996 to 2006 are expected to increase the cost of producing PWC over time. The corresponding increase in market price of PWC may lead to a reduction in sales that would reduce PWC ownership and use relative to the projected levels. This would tend to reduce the incremental costs and benefits attributable to NPS regulations in future years. However, production cost increases due to these regulations are probably captured in the current baseline to some degree because the rule has already required some reduction in emissions.

NPS identified the following additional uncertainties:

Although NPS has provided its best estimate of the regional economic impacts associated with the proposed alternatives, numerous sources of uncertainty may influence the results.

- The projections of PWC use through 2012 in the absence of a ban were based on NPS estimates of what annual PWC use would have been in 2003 in the absence of a ban (see Section 2.2.4 for uncertainties related to this estimate). This is turn was based on the estimates provided by LAMR staff of PWC use during 2001. To the extent that PWC users accounted for an unusually small or large proportion of total visitation during this period, projected visitation by PWC users may be understated or overstated.
- The trends in local population growth may not constitute a good proxy for the future annual change in visitation to LAMR by non-PWC users. It may understate or overstate the actual change in LAMR non-PWC visitation that would occur in future years under baseline conditions. The uncertainties associated with the baseline projections are discussed in further detail in Section 2.2.4.
- In the absence of a ban, PWC use in the future is assumed to remain at 2001 levels. This assumption is based on observations made by LAMR staff. Local and state PWC registrations fell sharply from 1998 to 2002. In addition, national PWC sales have fallen since 1995 (see Table 3-2).

Therefore, PWC use in the future may be overestimated in this analysis. However, in the absence of reliable time-series data for PWC use at LAMR, NPS assumes that park staff have the best information available for predicting PWC use in the future. The uncertainties associated with the baseline projections are discussed in further detail in Section 2.2.4.

- The proportion of PWC users who used the park prior to the ban and will return to visit the park following implementation of new regulations is unknown. The actual proportion of users who return to visit may be higher or lower than assumed in this analysis.
- The rule proposal process itself may have affected the number of PWC users who visited LAMR in 2001. If there was a reduction in PWC use in LAMR because of uncertainty over future restrictions on PWC use, then the results of this analysis will not reflect this reduction. However, it is not clear that the prospect of future restrictions would have caused a reduction in visitation. In fact, it may have led to just the opposite effect as people attempted to access LAMR prior to additional restrictions being implemented.
- NPS developed the scenarios used to predict impacts on local businesses based on conversations with a number of local businesses. To the extent that the expected impacts on these businesses are not representative of all affected businesses in the LAMR region, the estimated impacts may be influenced upwards or downwards.
- The estimates for the share of PWC and park-related business in total revenues of potentially affected businesses were based primarily on interviews with the businesses themselves. Because NPS was unable to obtain such figures from all potentially affected firms, the average of responses was used for these shares. Values for individual firms may be either greater or less than the average used by NPS.
- In some cases, NPS used estimates of business revenues from *InfoUSA*. However, these data are only provided in ranges. NPS used the midpoint of this range for the analysis, which may understate or overstate the actual revenue of a particular business.
- NPC identified the universe of affected entities by visiting the LAMR area and contacting potentially affected businesses. In addition, NPS used secondary sources such as *infoUSA* to help identify businesses in the region that may have revenues related to PWC use in LAMR. However, additional firms in the region may be directly affected by regulations on PWC use in LAMR. NPS spoke directly with only a subset of the potentially affected businesses.
- Generic spending patterns and multipliers from MGM2 were used to represent economic activity in the LAMR area. To

the extent that spending patterns of PWC users in LAMR differ from the generic spending of users and/or the generic multipliers for a national park in a small metropolitan area differ from the multipliers for the LAMR region, the impacts may be understated or overstated.

- In addition, the general uncertainties and caveats are associated with the use of I-O models. These factors are described in further detail in Appendix A.

4 Benefit-Cost Analysis of the Alternative Regulations

The purpose of benefit-cost analysis is to evaluate the social welfare implications of an action—in this case the regulation of PWC use in national parks. The impacts of this action, both the benefits and costs, will ultimately be experienced as changes in well-being for households/individuals.

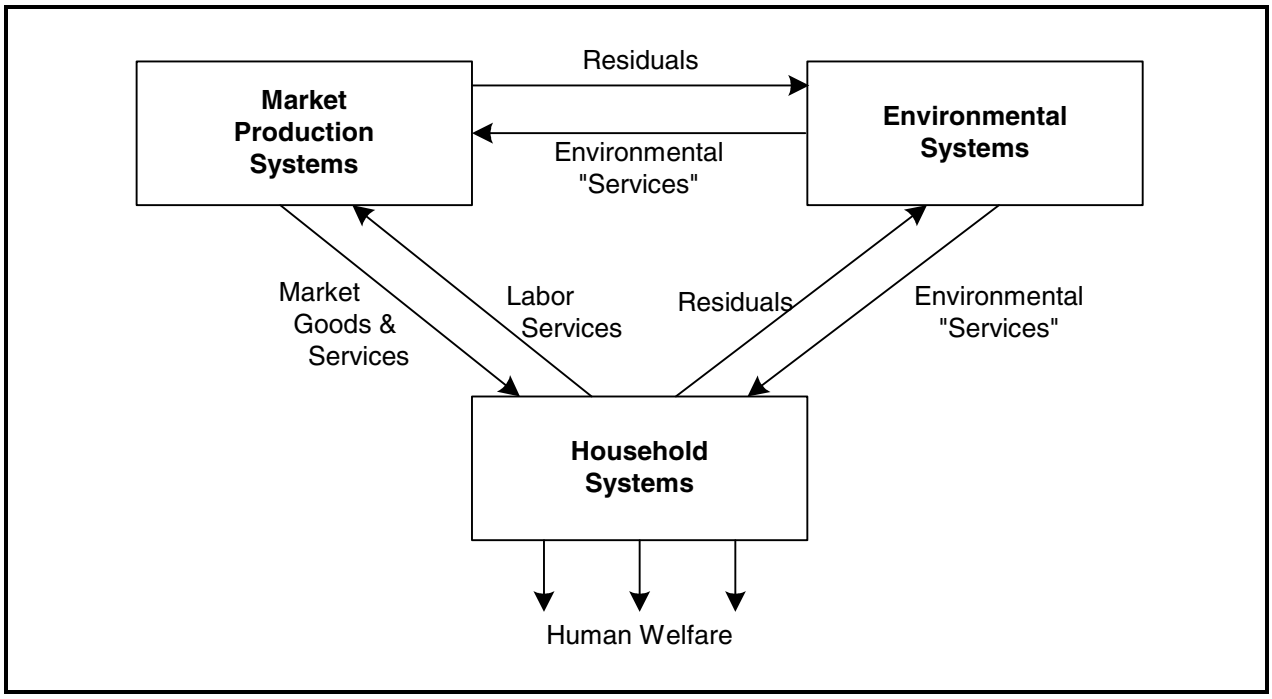
The purpose of benefit-cost analysis is to evaluate the social welfare implications of an action—in this case the management of PWC use in national parks. It examines whether the reallocation of society's resources resulting from the action promotes efficiency. That is, it assesses whether the action results in benefits (gains in social welfare) greater than the associated costs to society (losses in social welfare).

Section 4.1 provides a general outline of the approach to benefit-cost analysis and the possible benefits and costs of PWC regulations in national parks. Section 4.2 presents the analysis for LAMR specifically.

4.1 CONCEPTUAL BASIS FOR BENEFIT-COST ANALYSIS OF PWC RESTRICTIONS IN NATIONAL PARKS

According to the conceptual underpinnings of benefit-cost analysis, all social welfare impacts ultimately accrue to individuals. This is represented in Figure 4-1, which depicts flows of goods, services, and residuals among three major systems: market production, household, and the environment. Because these systems are closely interconnected, actions taken to reduce releases of harmful residuals (e.g., chemicals or noise pollution) to the environment will potentially reverberate throughout all of these systems.

Figure 4-1. Interrelationship Among Market, Environmental, and Household Systems and Social Welfare



Nevertheless, the impacts of regulatory actions, both the benefits and costs, will ultimately be experienced as changes in well-being for households/individuals. As a result, identifying and measuring benefits and costs must focus on these changes in well-being.

The conceptual framework depicted in Figure 4-1 therefore provides a basis for assessing the benefits and costs of PWC regulations in national parks. In these cases, the most direct impact will be on households that use PWC, whose recreational opportunities will be affected by the regulations. This will result in direct changes in welfare for these households. In addition, the resulting changes in the behavior of these households are likely to affect environmental systems and market systems. Effects on these systems will indirectly affect the welfare of other households. For example, the park environment will be improved or degraded, and this change will change the "services" (primarily recreation-related) that the park provides to other households and individuals in society. Businesses that cater to non-PWC visitors may also be affected if the number of people visiting the park changes. On the other hand, the resulting change in the market demand for PWC-related goods and services

will have impacts for those who own or work for establishments supplying these services.

These types of direct and indirect impacts are identified and evaluated as part of this benefit-cost analysis. Specifically, in Section 4.2 NPS estimates the incremental benefits and costs relative to the baseline.

In certain instances, welfare changes are directly the result of monetary gains or losses and can therefore be thought of as being equivalent to these gains or losses. In other instances, welfare changes are not directly associated with pecuniary gains or losses.

Estimating the value of benefits and costs also requires methods for expressing welfare changes in monetary terms. In certain instances, welfare changes are directly the result of monetary gains or losses and can therefore be thought of as being equivalent to these gains or losses. For example, welfare gains to PWC sales shops due to changes in demand for their services can be reasonably measured as their resulting net change in income. In other instances, welfare changes are not directly associated with pecuniary gains or losses. Such "nonmarket" changes might include, for example, the welfare gains or losses from improved or degraded recreational opportunities in a park. In these cases a surrogate measure of gains or losses must be used; willingness to pay (WTP) is such a surrogate. Economists and other practitioners of benefit-cost analysis generally accept WTP as the conceptually correct measure for valuing changes in individuals' welfare. WTP represents the maximum amount of money that an individual would be willing to forgo to acquire a specified change. As such, it is the monetary equivalent of the welfare gain from the change.

Using this conceptual framework for identifying, measuring, and valuing changes in societal welfare, the remainder of this section and Appendix B provide a more detailed discussion of

- ➤ the types of benefits and costs associated with PWC regulations in national parks, and
- ➤ the approaches used in measuring these benefits and costs.

4.1.1 Social Costs of PWC Use

Use of PWC in national parks may be associated with a number of negative impacts on environmental resources and ecosystems. The extent to which adverse impacts will be realized is a function of several factors, including the level of use, the technology of the machines being used, and the extent to which users remain in designated areas. One result of any negative impacts that occur is that they impose welfare losses on individuals who value the parks'

environmental systems. The negative impacts of PWC use on other people are also referred to as negative externalities. If PWC generate negative externalities, then this represents a market failure. The private cost of using a PWC (the cost to the individual PWC user) will be lower than the social cost of PWC use (where the social cost of PWC use includes both the cost to the PWC user plus the costs to others that result from the negative externalities associated with PWC use). Because PWC users do not have to pay the full social cost of using a PWC and instead only pay the lower, private cost, PWC use will be maintained at a higher level than socially optimal in the absence of regulation.

The private cost of using a PWC is lower than the social cost of PWC use. Because PWC users do not have to pay the full social cost of using a PWC and instead only pay the lower, private cost, PWC use will be maintained at a higher level than socially optimal in the absence of regulation.

The costs of allowing PWC in national parks can therefore be thought of and measured as the increase in these incremental losses to society. In addition, use of PWC can negatively affect society in ways that are not directly related to the environment; therefore, the incremental costs of PWC regulations allowing PWC use must also include increases in these nonenvironmental losses.

Table 4-1 provides a broad classification of the types of environmental and nonenvironmental impacts associated with PWC use in national parks. In this section, this classification is used to more completely identify, categorize, and describe the full range of potential costs associated with PWC regulations in national parks in general. In Section 4.2.3, this framework is then used to specifically describe the costs that are expected to result from the proposed management alternatives for LAMR.

Table 4-1. Classification of Potential Negative Impacts from PWC Use in National Parks

Impact Categories	Examples of Impacts
Environmental impacts	
Aesthetic	Noise, visibility, odor
Human health	Through impacts to air and water quality
Ecosystems	Loss of or damage to habitat and wildlife
Nonenvironmental impacts	
Infrastructure	Costs of monitoring, maintenance, and law enforcement
Human safety	Accidents
Cultural, historical, and archeological	Physical damages

The value that people place on a particular recreational activity depends strongly on the availability of substitutes. In areas where there are numerous areas available for recreational activities, the value of changing environmental conditions in one of those areas will tend to be smaller.

Environmental Costs of PWC Use

The use of PWC may have adverse impacts on air quality; natural resources (e.g., water quality, habitat); wildlife; and natural quiet. Figure 4-2 depicts the various categories of potential adverse effects to the environment through which PWC use in national parks can impose welfare losses on society.

- Typical (two-stroke) PWC release substantial amounts of noise and pollutants into the environment. Noise from PWC impairs the natural soundscape for park visitors and has the potential to negatively affect wildlife in the park. Emissions from PWC can also negatively affect park ecosystems, human health, and visitor experiences. The three primary reasons for the potential impacts due to release of pollutants are:
  - ✓ up to one-third of the fuel delivered to the engine is expelled without being burned,
  - ✓ lubricating oil is mixed with fuel and thus is expelled as part of the exhaust, and
  - ✓ the combustion process results in high emissions of air and water pollutants.

Pollutants are directly released to air and water, causing contamination of air and water resources.

As shown in Figure 4-2, all of these impacts can, directly or indirectly, lead to losses in human welfare. Therefore, from a benefit-cost perspective, those who ultimately lose from actions to allow PWC will be individuals who value the quality of the park environment. Many of those that experience losses will be park visitors whose recreational experiences are disturbed. As a point of reference, Table 4-2 reports average consumer surplus values that have been estimated for common non-PWC-related summer recreation activities from a study by Rosenberger and Loomis (2000). These are the types of recreation values that may be diminished by the presence of PWC.

The value that people place on a particular recreational activity depends strongly on the availability of substitutes. In regions where there are numerous areas available for recreational activities, the value of changing environmental conditions in one of those areas will tend to be smaller. The reason is that there are already many other areas where people can engage in the same activity. Unless there are unique characteristics that people value in the area where

Figure 4-2. Routes of Environmental Damages and Human Welfare Losses from PWC Use in National Parks

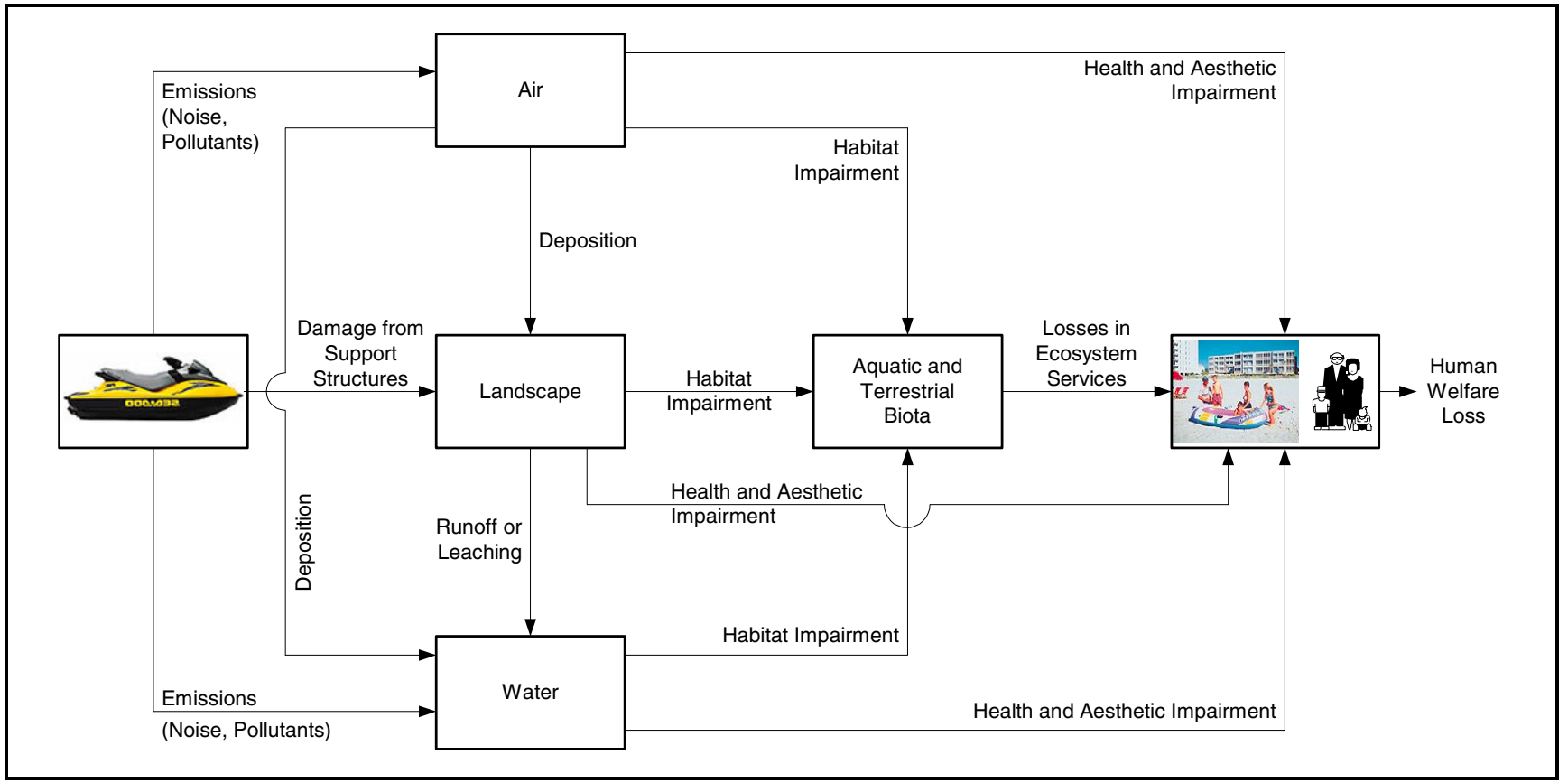


Table 4-2. Summary of Average Recreation Values (2001$ per Person per Day) for Selected Activities by Region[a,b]

Activity	Study Location					U.S. Average
	Northeast	Southeast	Mountain	Pacific	National[c]	
Picnicking	59.46 (1)	40.10 (1)	39.10 (7)	79.62 (2)	16.89 (1)	45.78 (12)
Swimming	40.06 (5)	NA	NA	16.10 (1)	22.26 (1)	34.10 (7)
Hiking/backpacking	48.46 (2)	118.40 (2)	40.29 (3)	21.95 (6)	22.47 (1)	43.48 (14)
Fishing	34.06 (42)	29.87 (13)	45.75 (39)	39.96 (16)	40.12 (4)	38.62 (114)
Motor boating	56.46 (2)	NA	74.04 (2)	16.29 (1)	41.67 (1)	53.16 (6)

NA = Not available.

[a]All amounts were inflated using the consumer price index for recreation available from the U.S. Bureau of Labor Statistics (2002). Numbers in parentheses represent the number of observations (i.e., studies).

[b]These values were taken from multiple studies conducted between 1967 and 1998.

[c]Studies estimating nationwide values.

Source: Rosenberger, Randall, and John Loomis. 2000. "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36(4):1097-1107.

conditions will be improved or degraded, there will probably be relatively small benefits or costs as a result of the environmental change. On the other hand, in regions with few substitutes for the local national park that would potentially experience environmental damage as a result of the regulations, the losses to park users may be much greater.

Even individuals who are not park visitors (i.e., nonusers) can benefit from the knowledge that park resources are being protected and preserved. In other words, they may hold positive or negative "nonuse values" (i.e., a positive WTP) for protecting or degrading the park environment. These nonuse values can stem from the desire to ensure others' enjoyment (both current and future generations) or from a sense that these resources have some intrinsic value. Pearce and Moran [1994] review studies that have attempted to estimate nonuse values for the protection of unique species and ecosystems. The measurement of nonuse value remains controversial, and in this report NPS does not attempt to quantify the possible benefits or costs associated with nonuse values. Allowing PWC use in national parks can therefore result in losses to both users and nonusers in a number of ways by degrading the parks' ecological resources.

Appendix B provides a detailed discussion of the nonenvironmental impacts in particular, and how these restrictions can affect public safety in national parks and the costs of operating and maintaining the infrastructure necessary to support and monitor PWC use.

4.1.2 Social Benefits of PWC Use

The primary benefits associated with allowing the use of PWC in national parks will accrue to

- PWC users, in particular individuals who have not been able to use PWC in a park as a direct result of restrictions on PWC use, and
- providers of PWC-related services for park visitors.

After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and other experts, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip.

Just as Section 4.1.1 described potential consumer surplus losses to other park visitors and the public associated with PWC use, the potential welfare gains to PWC users are measured in terms of consumer surplus. Regulations that restrict the use of PWC impose costs on PWC users. For instance, prohibiting PWC use in the park has resulted in a loss of consumer surplus for former LAMR PWC users. Reinstating PWC use in LAMR under restrictions such as limiting the areas of the park that are open to PWC, imposing no-wake zones, or requiring newer technology would increase the consumer surplus of PWC users relative to baseline. A return to pre-ban PWC management practices would increase the consumer surplus of PWC users even further.

As with other activities, the extent of the welfare gain to an individual rider depends crucially on the availability of substitute areas to ride or other activities. All else equal, individuals who have fewer substitutes for PWC use (either other places to use PWC or other activities they enjoy as much) enjoy greater consumer surplus from PWC use in a particular waterbody and thus will experience a greater gain in welfare if the waterbody is opened to PWC use.

After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and other experts, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip. Table 4-2 presents the results of a review of the recreation literature conducted by Rosenberger and Loomis (2000). The review found an average value of $49.37 (1996 dollars) per

person per day for riding in motor boats (with estimates ranging from $15 to over $65). The same study reports a value of $26.79 (1996 dollars) per person per day (with estimates ranging from $20 to over $30) for off-road driving. Bhat et al. (1998) report consumer surplus estimates ranging from $9.12 to $54.93 for motorboating and waterskiing in different regions of the country. These estimates, along with the estimates in Table 4-2, provide a range of values for activities similar to riding PWC and provide a bound on the consumer surplus gain for PWC users expected from the proposed regulations. Note that measures of net consumer surplus to PWC riders that do not account for the additional costs imposed on society by the negative externalities associated with PWC use will overstate the true net social welfare associated with the activity.

Even PWC users who do not currently visit the park may have a positive value associated with maintaining access for PWC in parks that they could potentially decide to visit in the future. These users hold an option to visit the park in the future. Restrictions on PWC access to parks would reduce or eliminate the value of that option. Thus, PWC users that do not visit the park may still experience a gain in welfare if the park allows PWC use. However, due to a lack of information concerning the population of PWC users who may potentially choose to visit a given park in the future and the value that they place on that option, NPS does do not attempt to quantify the potential gains in option value.

An increase in PWC use at a particular park may also impact businesses that offer services to PWC users. These businesses are not directly affected by NPS regulations of PWC users (i.e., none of the regulations directly require any action from PWC dealerships, rental shops, or other businesses), but are likely to be impacted nonetheless. For example, allowing PWC use in national parks may lead to increased demand for PWC sales or rentals and decreased demand for motorboats or canoes. These shifts in demand may reallocate sales among businesses and may lead to an increase in total revenue for businesses providing tourism-related services. As described in Section 3, there may also be ripple effects on the local economy. If businesses that serve PWC users experience an increase in demand for their services, they will most likely increase their purchases of inputs from other sectors of the local economy, including labor. In addition, an increase in revenue for local firms

tends to increase regional income. Increases in average household income for the region surrounding the park will also lead to increases in sales for local businesses as local households respond by purchasing more goods (see Appendix A for more detailed information on ripple effects).

Whether these indirect, or secondary, impacts should be included as a change in social welfare in the benefit-cost analysis depends on whether the change in demand or supply in the secondary market results in prices changes (for details, see a benefit-cost analysis textbook such as Boardman et al. [1996]). In general, when the policy change in the primary market (PWC trips to a national park) causes prices to change in the secondary markets, the net change in social welfare from the secondary market should be included in the benefit-cost analysis. If prices do not change in the secondary market, the revenue gains or losses should not be included in the benefit-cost analysis. If the people who would have used PWC in the national park spend their money elsewhere instead, this represents a transfer from one region of the country to another or from one business to another. Although the loss in revenue may hurt the businesses located near the national park, from society's point of view this represents a transfer of income rather than a true cost to society as a whole.

Without more detailed information, it is difficult to predict with certainty whether the proposed alternatives will change prices for PWC sales or rentals. However, NPS believes the changes in demand that would occur under these alternatives may result in price changes for PWC-related markets. Thus, losses or gains to tourism-related businesses that may be indirectly affected by the alternative management strategies are included in the benefit-cost analysis.

4.2 RESULTS FOR LAKE MEREDITH NATIONAL RECREATION AREA

Based on the approach and possible impacts outlined above, this section presents the results of the benefit-cost analysis for LAMR. The section discusses the groups most directly affected by the proposed alternatives for managing PWC use in the park and several scenarios for the possible levels of impacts. The benefits and costs accruing to these groups, relative to the baseline (where PWC are banned from LAMR), are then presented.

4.2.1 Affected Groups

For the purpose of this study, six major affected groups, listed in Table 4-3, have been identified:

1. PWC users, in particular those who used PWC in LAMR prior to the November 2002 ban and those who may wish to use PWC in LAMR in the future.
2. Other visitors or potential visitors who may have a different experience at the park if PWC remain banned or are otherwise restricted in LAMR (canoeists, anglers, swimmers, hikers, boaters, and other visitors).
3. Producers of PWC services in the area surrounding LAMR who may experience a change in their welfare when PWC use in the park changes (e.g., PWC rental shops, PWC sales shops, restaurants, gas stations, hotels).
4. Local residents of the area surrounding LAMR (not including those in any of the five other user groups).
5. Producers of services for other types of summer visitors (e.g., canoe rentals or powerboat rentals) who may experience a change in their welfare related to the number of PWC users in the park.
6. The general public who may care about the natural resources in LAMR even if they do not visit the park.

The impacts on these groups under each alternative are discussed in more detail below.

Alternatives A and B, which authorize PWC use, negatively affect non-PWC park visitors and the general public. PWC users will gain consumer surplus under both of these alternatives.

Alternatives A and B negatively affect non-PWC park visitors and the general public because PWC use in LAMR would be reinstated. PWC users will gain consumer surplus under both of these alternatives. Under Alternative B, PWC users who consider the no-wake zones and mandatory refueling at the designated marina to be negative impacts may not regain the full value of their consumer surplus. NPS estimates that the regulations proposed under Alternatives A and B will increase PWC rental and sales revenues relative to baseline conditions. Local shops with PWC-related revenue will experience gains in producer surplus to the extent that these changes cause PWC users to return to LAMR.

Under Alternatives A and B, NPS expects negative welfare effects for all park visitors and the general public except PWC users and the businesses that cater to them. PWC users, PWC rental and sales shops, and other businesses that provide services to PWC users are expected to experience gains of consumer and producer surplus. Adverse impacts of PWC on other users within LAMR are increased

Table 4-3. Impact of Alternatives on User Groups

User Group	Alternative A	Alternative B	Alternative C (No-Action Alternative)
1. PWC users or potential PWC users	• Consumer surplus is expected to increase as a result of lifting the ban on PWC in LAMR.	• Consumer surplus is expected to increase as a result of lifting the ban on PWC use in LAMR, although less than under Alternative A because of no-wake and refueling restrictions.	• No change in consumer surplus.
2. Other visitors or potential visitors: canoe users, anglers, other boaters, swimmers, hikers and other visitors	• Consumer surplus is expected to decrease for current users of LAMR as a result of increased noise, decreased water quality, and an increase in the risk of accidents involving PWC. • Consumer surplus is expected to decrease for potential visitors who would have visited LAMR with the ban on PWC use.	• Consumer surplus is expected to decrease slightly for current users of LAMR as a result of decreased solitude, decreased water quality, and an increase in the risk of accidents involving PWC. • Consumer surplus is expected to decrease for potential visitors who would have visited LAMR with the ban on PWC use.	• No change in consumer surplus.

(continued)

Table 4-3. Impact of Alternatives on User Groups (continued)

User Group	Alternative A	Alternative B	Alternative C (No-Action Alternative)
3. Producers of PWC services: PWC rental shops, PWC sales shops, other parts of the local economy providing services to PWC users	• Producer surplus may increase for PWC rental shops. • Producer surplus may increase for PWC dealerships as a result of a rise in sales and servicing of PWC. • Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a significant increase in producer surplus.	• Producer surplus may increase for PWC rental shops. The increase would likely be smaller than under Alternative A. • Producer surplus may increase for PWC dealerships as a result of a rise in sales and servicing of PWC. The increase would likely be smaller than under Alternative A. • Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a significant increase in producer surplus. • The marina that is allowed to sell fuel on the lake would benefit from increased fuel sales under this alternative. All other firms selling fuel to PWC users on the lake would lose producer surplus under this alternative.	• No change in producer surplus.
4. Local residents of the area surrounding LAMR	• Local residents of nearby areas are not expected to experience a measurable change in welfare.	• Local residents of nearby areas are not expected to experience a measurable change in welfare.	• No change in welfare.

(continued)

Table 4-3. Impact of Alternatives on User Groups (continued)

User Group	Alternative A	Alternative B	Alternative C (No-Action Alternative)
5. Producers of services for visitors to LAMR who do not use PWC	• Producer surplus is expected to decrease slightly because lifting restrictions on PWC may result in a small decrease in demand for angling, canoeing, and other activities in the park, resulting in a decreased demand for the provision of services related to these activities.	• Producer surplus is expected to decrease because lifting restrictions on PWC may result in a decrease in demand for angling, canoeing, and other activities in the park, resulting in a decreased demand for the provision of services related to these activities. This decrease may be smaller than under Alternative A.	• No change in producer surplus.
6. The general public who may care about LAMR even if they do not visit	• May experience a decrease in welfare as a result of degraded nonuse values resulting from decreased environmental quality in the seashore.	• May experience a decrease in welfare as a result of degraded nonuse values resulting from decreased environmental quality in the recreation area. The decrease in welfare is expected to be smaller than under Alternative A because of the restrictions and limitations of PWC use in LAMR.	• No change in welfare.

under Alternatives A and B because PWC will be allowed within the park's boundaries. In addition, allowing PWC in the park would have negative impacts on other boaters' consumer surplus because of the increased probability of accidents between boaters and PWC users and increased noise levels. However, it is possible that congestion will decrease in non-NPS waters and the risk of accidents might actually decrease overall.

Alternative C, which maintains the ban on PWC use, will have no effect on any of the user groups relative to projected baseline conditions.

4.2.2 Scenarios

NPS considers current conditions, a complete ban on PWC in LAMR, to be the baseline with which the alternatives are compared.

To develop estimates of the benefits and costs of the proposed rule under each alternative, NPS used the scenarios described below (see also Section 3.1). NPS considers current conditions, the complete ban on PWC in LAMR, to be the baseline to which the alternatives are compared. It should be noted, that under the baseline projections, park-related PWC rentals were assumed to have declined by 100 percent relative to pre-ban levels, and PWC sales are assumed to have declined by 75 percent relative to pre-ban levels.

Alternative A

Alternative A allows PWC use in LAMR according to the rules and regulations that were in effect prior to the ban in 2002. For Alternative A, it is expected that PWC users who previously used PWC in the park would return as a result of the regulation. PWC rentals, storage, and sales are assumed to return to pre-ban levels under Alternative A. It is also assumed that local convenience stores will regain 100 percent of park-related PWC revenues as a result of the reduction in visitation predicted for a ban on PWC in LAMR.

Alternative B

The second alternative allows PWC use in LAMR with additional no-wake and refueling restrictions. For this alternative, NPS assumes that PWC sales and rentals will return to 95 percent of pre-ban levels. In addition, the marina is estimated to have a 1 percent increase in total revenues relative to pre-ban conditions as a result of the fueling restrictions. It is also assumed that local convenience stores will regain 95 percent of PWC-related revenues relative to

baseline as a result of the reduction in visitation predicted for a ban of PWC in LAMR.

Alternative C (No-Action Alternative)

This alternative continues the ban on the use of PWC in LAMR that became effective in November 2002. Under this scenario, NPS assumes no change in PWC rentals or PWC sales relative to the baseline.

4.2.3 Costs

As described in Section 4.1 and Appendix B, PWC use in national parks can be linked to a wide variety of negative impacts. Allowing their use in these parks can therefore result in a number of different costs to society. Section 2.5 specifically describes the impacts on natural resources that are most likely to result from PWC use within the boundaries of LAMR. This section describes how these impacts will be affected by the regulatory alternatives identified above and assesses the costs of these regulations. Assessing these benefits in strictly quantitative (i.e., monetary) terms is not feasible with currently available data; therefore, the costs are described in qualitative terms.

The group of visitors who would bear the largest share of the costs associated with Alternatives A and B would be LAMR visitors who do not use PWC and whose park experience would be negatively affected by the use of PWC in the park.

The group of visitors who would bear the largest share of the costs associated with Alternatives A and B would be LAMR visitors who do not use PWC and whose park experience would be negatively affected by the use of PWC in the park. In LAMR, other popular activities include canoeing, fishing, boating, camping, swimming, and hiking. Average annual visitation to LAMR was just under 1.6 million people from 1997 to 2001. Most of these visitors are believed to come to the park for some form of water-based recreation, but according to NPS estimates, only about 1.14 percent of visitors are PWC users (see Section 2.2).

"Nonusers" of the park are also likely to experience costs as a result of the proposed measures (see Section 4.1 and Appendix B for more details). For example, individuals who do not visit the parks can experience a decline in welfare simply from the knowledge that the natural resources of the park may be degraded by PWC use. Part of this loss may stem from a decreased assurance that the quality of the parks' resources is being protected for the enjoyment of future generations. Therefore, some of the cost categories described below, in particular those associated with the degradation of unique

park resources and ecosystems, may accrue in the form of nonuse values.[1]

Aesthetic Costs—Noise and Visibility Impairments

Alternatives that reinstate PWC use will increase noise levels in LAMR and reduce the level of natural quiet along portions of the shoreline. They also have the potential to degrade visibility by leading to an increase in the amount of ozone-causing emissions. However, because a large number of motorized boats already operate along the shore in the baseline, the incremental negative impacts of allowing PWC in the park are likely to be very small.

Alternative A: This alternative will have the greatest impact because it will allow PWC in all areas in LAMR. However, as described above, noise from other boating activities infiltrates the bay and remaining park areas. Because of the small percentage of PWC use compared to other watercraft, changes to soundscape quality are expected to be slight. It is expected that with improved technology, quieter PWC will become the standard, and sounds generated by PWC will decrease over time.

Alternative B: Negligible to minor detrimental impacts in soundscape quality relative to baseline are anticipated under this alternative. Alternative B will implement no-wake zones for PWC and other watercraft in a back cove waters of LAMR. These areas may not experience a noticeable change in noise as a result of lifting the ban on PWC.

Alternative C (No-Action Alternative): This alternative continues current policy and offers no change in soundscape relative to current conditions.

Allowing PWC under Alternatives A and B will result in additional aesthetic costs to recreators in the parks, such as canoeists, anglers, birdwatchers, and hikers, relative to baseline conditions. Noise

[1] The importance of recognizing these values is affirmed in the Organic Act. It established the fundamental purpose of the national park system, which includes providing for the enjoyment of park resources and values by the people of the United States. The mandate applies not just to the people who visit parks—but to all people—including those who derive inspiration and knowledge from afar. Furthermore, through the Redwood Act of March 27, 1978, Congress has provided that when there is a conflict between conserving national park resources and values and providing for enjoyment of them, conservation is to be the primary concern.

emissions have been identified as a particular nuisance to nonmotorized recreators, such as canoeists and hikers, who tend to place a particularly high value on the tranquility and natural soundscape offered by the parks. Anglers using motorized boats also value the natural soundscape, and while fishing, often operate their boats with quiet electric motors to avoid disturbing fish. Therefore, increasing noise from PWC activity in the parks would degrade the experience of both motorized and nonmotorized recreators.

In addition to generating high noise levels, PWC also emit strong-smelling fumes that can be bothersome to other recreators and reduce visibility. These effects tend to be much more localized than noise emissions. Finally, NPS assumes that visibility impacts from PWC emission increases from allowing PWC under Alternatives A and B will be negligible.

Human Health Costs

PWC emissions contain relatively high levels of pollutants such as VOC, CO, PM, NO_x, and HCs, which are potentially damaging to human health. It is very unlikely that the level of PWC use in LAMR prior to the ban in 2002 represented a significant health threat to humans; nevertheless, the potential for adverse health effects exists. For example, some of the toxic HCs are potentially harmful even at very low levels of exposure (EPA, 2000a; EPA, 1999a). The large number of other motorized watercraft that operate in LAMR means that allowing PWC would result in only a small increase in emission levels. In summary, the health costs from the proposed regulations are expected to be negligible to minor for all of the alternatives.

Ecosystem Degradation Costs

As discussed in Sections 2 and 4.1 of this report, PWC use has the potential to negatively affect ecosystems and natural habitats in a variety of ways. In the case of national parks, these natural resources are of particular value to the public. Although levels of PWC use prior to the ban in LAMR are not expected to have caused widespread ecosystem damages, allowing PWC in the parks can nonetheless result in costs to visitors and nonusers by potentially degrading some of the parks' natural resources.

Alternative A: This alternative may have some negative impact on water quality. However, in general, allowing PWC in LAMR as

proposed under Alternative A is not expected to result in exceedances of and human or eco-toxicological water quality benchmarks. The PWC-specific incremental effect would be small because of the presence of other motorized watercraft.

Alternative B: This alternative would have similar impacts on water quality as Alternative A, although the fueling restrictions under this alternative may result in less fuel spillage and contamination. The no-wake restrictions might dissuade PWC operators from using these sites. The PWC-specific effect would be small because of the presence of other motorized watercraft.

Alternative C (No-Action Alternative): This alternative offers no costs to society for ecosystem degradation compared to the current situation.

As discussed in Section 2.5, fish and wildlife may be adversely affected by the use of PWC in the park. In addition to being a potential nuisance to other recreators, noise from PWC may disturb wildlife. Localized, short-term but negligible effects on wildlife may occur under Alternatives A and B by increasing noise disturbance and the chance for collisions with wildlife. Although no water quality impacts associated with PWC use in LAMR have been documented, there may be a long-term negative impact to aquatic biota and the ecosystems in the park because of minor degradations in water quality and an increase in physical disturbances.

Introducing potential harm to the park's ecosystems will result in welfare losses for park visitors, for example by decreasing their chances of viewing wildlife in a less stressful environment. It will also result in welfare losses to individuals across the country who value the park's unique ecosystems and natural habitats, regardless of whether they actually visit the park. That is, degrading the park's ecosystems can result in nonuse costs to society.

Safety and Congestion Costs

In addition to environmental costs associated with increases in PWC use, there may also be safety and congestion costs. Since 1990, injuries associated with the recreational use of PWC have increased at least four-fold. The number of injuries reported from PWC use is now higher than that reported from motorboat use in the U.S. (Branche, Conn, and Annest, 1997). Because of the

disproportionately large number of injuries associated with PWC use, allowing their use may decrease the safety of park visitors. In addition, the level of congestion is an important factor determining visitor enjoyment. Increases in congestion related to PWC use may therefore have costs to other park users.

Alternative A: Alternative A allows PWC in the park, and it may harm all recreators by increasing their risks of being involved in accidents with PWC.

Alternative B: Potential costs resulting from Alternative B include those discussed for Alternative A, but they may be less severe as a result of no-wake restrictions.

Alternative C (No-Action Alternative): This alternative offers no costs to society related to safety and congestion compared to the current situation.

Any increase in accidents that may result from the return of PWC to LAMR will increase the costs to NPS associated with medical/rescue operations, which may require resources to be redirected from other park management activities. However, these costs are not likely to be large in LAMR.

4.2.4 Benefits

For visitors who used PWC in LAMR prior to the ban or who want to ride in the park in the future, allowing PWC use in the park could result in consumer surplus gains.

PWC users, as well as some businesses in the local area, may experience welfare gains as a result of management alternatives that permit PWC use in the park.

Benefits to PWC Users

Two main groups of PWC users may be affected by the proposed regulations: those who used PWC in LAMR prior to the ban and those who use PWC in substitute areas outside LAMR where PWC users displaced from LAMR may have increased their use since PWC use in LAMR was banned.

PWC users who currently ride in nearby areas where displaced riders from LAMR may have visited will gain some consumer surplus if these areas become less crowded because of lifting restrictions on PWC use in LAMR. Although no studies were available that examined the impact of congestion on the value of a PWC trip, other recreation demand studies find that congestion lowers the value of a recreation experience (see Appendix B). For

PWC users who rode in LAMR prior to the ban or who want to ride in the park in the future, allowing PWC use in the park could result in consumer surplus gains. To the extent that individuals consider other PWC areas close substitutes, the change in consumer surplus associated with allowing PWC use in the park will be lower. In the case of LAMR, several nearby substitute areas have less stringent regulations (see Section 2.3).

If each individual's demand curve for riding a PWC in LAMR were known, then NPS could add up the gain of consumer surplus for each individual to find the total change in consumer surplus to PWC riders from the proposed regulations. Because the demand curve reflects the individual's preferences for available substitute activities and the cost of these activities, measuring the change in consumer surplus from a trip in the park takes into account substitute activities. In this case, NPS does not know the consumer surplus associated with PWC use in LAMR, nor does NPS know the riders' next best alternative activities.

To assess the incremental change in consumer surplus for PWC users, NPS used the benefit transfer technique.

To assess the incremental change in consumer surplus for PWC users, NPS used the benefit transfer technique. After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and experts at other consulting firms, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip. A review of the recreation literature conducted by Rosenberger and Loomis (2000) found an average value of $31.98 (1996 dollars) per person, per day for riding in motor boats in the entire United States (with estimates ranging from $15 to over $50). Bhat et al. (1998) estimate an average consumer surplus of $28.56 (1998 dollars) associated with motorboating and waterskiing in an area that includes parts of the western edge of Texas (along with California, Arizona, and New Mexico). Converted to 2001 dollars, the average consumer surplus reported in this study is $31.03. The estimate comes from a travel cost model based on data from the Public Area Recreation Visitors Study (PARVS). The PARVS data were a multiagency survey that included on-site interviews of recreationists at over 350 sites across the U.S. between 1985 and 1992. For the benefit transfer, NPS used the value from Bhat et al. (1998) based on the following criteria:

- ➤ Waterskiing and motorboating are similar activities to PWC use.
- ➤ The region where the data were collected includes the western part of Texas, where the study site is located.
- ➤ Bhat et al. (1998) was published in a peer-reviewed journal. The authors estimate a travel cost model using data from on-site interviews and only estimate values for activities in a particular region for which at least 100 observations were collected.

Below NPS discusses the estimated impact of each proposed alternative on PWC users.

Alternative A: This alternative would result in allowing PWC use in LAMR. Those visitors using PWC in LAMR prior to the ban would regain the full value of their consumer surplus for rides in LAMR.

Alternative B: This alternative would result in allowing PWC use only in certain areas of LAMR. Those riders who used PWC in LAMR prior to the ban and would return to LAMR under Alternative B would regain the full value of their consumer surplus for rides in LAMR. Those visitors who used PWC in LAMR prior to the ban but would not return because of the no-wake and refueling restrictions in place would not experience gains in consumer surplus due to the change in LAMR PWC regulations.

Using the value of $31.03 for a day of PWC use, NPS provides estimates of possible incremental gains in consumer surplus to PWC users as a result of Alternatives A and B.

Alternative C (No-Action Alternative): Under Alternative C, NPS anticipates no change in PWC use as a result of the regulation. Consumer surplus to PWC users will remain unchanged from current conditions.

Using the value of $31.03 for a day of PWC use, NPS provides estimates of possible incremental gains in consumer surplus to PWC users as a result of Alternatives A and B. NPS assumes that visitors who return to use PWC in LAMR will gain the full value of consumer surplus associated with a day of PWC use. Table 4-4 summarizes the projected consumer surplus losses for PWC users in LAMR for Alternatives A and B from 2002 to 2012 and the present value (PV) of these losses using both 3 percent and 7 percent discount rates. The PV is the value of a future stream of benefits or costs, discounted to current years. Under Alternative C, there will be no change in PWC use relative to baseline conditions and therefore no change in consumer surplus derived by PWC users.

Table 4-4. Projected Incremental Change in Consumer Surplus for PWC Users Under Alternatives A and B, 2003–2012 (2001$)[a]

	Alternative A		Alternative B	
Year	Change in Number of People Using PWC	Change in Consumer Surplus ($)	Change in Number of People Using PWC	Change in Consumer Surplus ($)
2003	18,197	$564,630	17,287	$536,400
2004	18,197	$564,630	17,287	$536,400
2005	18,197	$564,630	17,287	$536,400
2006	18,197	$564,630	17,287	$536,400
2007	18,197	$564,630	17,287	$536,400
2008	18,197	$564,630	17,287	$536,400
2009	18,197	$564,630	17,287	$536,400
2010	18,197	$564,630	17,287	$536,400
2011	18,197	$564,630	17,287	$536,400
2012	18,197	$564,630	17,287	$536,400
PV(3%)[b]	NA	$4,676,120	NA	$4,442,330
PV(7%)[c]	NA	$3,706,280	NA	$3,520,980

[a]All impacts were rounded to the nearest $10.

[b]The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rat in the valuation of lost natural resources use (61 FR 453; 61 FR 20584).

[c]Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

Uncertainty: The estimates of consumer surplus gains to PWC users are uncertain for a variety of reasons. Some of the main sources of uncertainty are as follows:

- The estimate of the number of PWC users who used LAMR prior to the ban is uncertain, as are the projections of future PWC use under Alternatives A and B.
- The actual consumer surplus associated with PWC use in LAMR may be different from the value used in the analysis. The value used in the analysis is based on studies of riding in motor boats and waterskiing. In addition, the value is based on a full day of motorized water-based recreation. To the extent that PWC users use PWC for only a small fraction of the day, spending the rest of the day engaged in more traditional beach activities, consumer surplus for PWC users may be closer to non-PWC users' surplus value (estimated in

Section 4.2.3) than to other motorized watercraft users' surplus.

- The values in Table 4-4 may overstate true gains under Alternative B because of assumptions about the consumer surplus of PWC users who return to ride in the park. In the analysis of Alternative B, PWC users who return to use PWC in LAMR may be inconvenienced by no-wake and refueling restrictions. These requirements may decrease the consumer surplus associated with using a PWC in LAMR even for those riders who use PWC in the park.
- The 1996 EPA Marine Engine Rule may result in lower PWC use in the future if the cost of new machines increases. If fewer riders would visit the park, the incremental consumer surplus gains associated with Alternatives A and B would be lower.

Benefits to the Local Area Businesses

If PWC use increases as a result of the regulation, then the suppliers of PWC rental, sales, and service will be directly affected. In addition, lodging establishments, restaurants, gas stations, and other businesses that serve PWC riders could experience an increase in business from the proposed regulation. The following section describes the approach used to develop quantitative estimates of these impacts and reports the results of the cost analysis for local area businesses.

PWC Sales and Rental Services. NPS identified six firms that own and operate one or more PWC sales, service, or rental shops near LAMR. Five of these firms sell new or used PWC (these shops generally also provide PWC service) and one provides PWC rentals. As described in Section 3.1, NPS estimated the changes in visitation and local business revenues that would result from each of these alternatives.

Lodging Establishments, Restaurants, Gas Stations, and Other Businesses. Purchases made by PWC users contribute to total economic activity in the area surrounding LAMR. It is possible that positive localized impacts on tourism-related businesses located near LAMR will occur if changes in PWC management result in changes in visitation to the recreation area. The proposed restrictions could affect lodging establishments, restaurants, gas stations, and retail stores in the area. These establishments may be affected if the proposed restrictions lead to changes in visitation to the park and surrounding area. However, PWC users comprise a small fraction

(approximately 1.14 percent) of total visitation to LAMR. Therefore, lodging establishments, restaurants, gas stations, and other businesses that serve PWC riders are not likely to experience a significant change in business under any of the alternatives.

Based on the existing data and interviews with local businesses, NPS expects Alternatives A and B will result in increases in PWC revenue associated with LAMR. The expected increases are described in Section 3.1. Based on the scenarios outlined in Section 3.1 for each of the alternatives, NPS calculated revenue increases (see Table 3-6).

To translate increased revenue into changes in producer surplus for purposes of benefit-cost analysis, NPS used estimates of the increase in revenue associated with the rule and return-on-sales measure for the Standard Industrial Classification (SIC) code provided by Dun & Bradstreet (D&B). The use of this profit margin only approximates gains in producer surplus. Producer surplus captures the difference between variable costs and revenue, while return on sales contains other measures reflecting fixed costs, taxes, and/or accounting conventions rather than measures of variable profits. For this reason, the use of D&B accounting profit margin data may understate producer surplus gains.

The profit ratios, net profit after tax divided by sales, come from D&B (2001).[2] For instance, the upper quartile profit ratio for sales shops is 4.6 percent and the lowest quartile is 0.6 percent. For rental shops, the upper quartile profit ratio is 8.7 percent and the lowest quartile is –3.4 percent. However, none of the rental shops that NPS interviewed indicated that they had a negative profit margin. Therefore, NPS used the median profit ratio (3.9 percent) in this analysis. Estimated profit ratios for each of the industries expected to be directly affected by PWC restrictions in LAMR are provided in Table 4-5.

[2]D&B data for North American Industry Classification System (NAICS) codes are not currently available. Therefore, NPS used the comparable SIC code 5571 (Motorcycle Dealers) as defined by the U.S. Census (i.e., SIC 5571, Motorcycle Dealers) for PWC dealerships. For rental shops, NPS used SIC code 7999 (Amusement and Recreation NEC).

Table 4-5. Profit Ratios Used for Calculating Changes in Producer Surplus

	Profit Ratios		
	SIC	Bottom Quartile	Upper Quartile
PWC rentals	7999	3.9%	8.7%
PWC sales	5571	0.6%	4.6%
Restaurants and bars	5812	0.6%	7.5%
Grocery stores	5411	0.4%	3.0%
Gas and oil	5541	0.1%	3.1%
Souvenir shops and other retail establishments	5947	1.1%	9.9%

For businesses in the LAMR region, estimated producer surplus gains associated with imposing the regulatory alternatives relative to the baseline are presented in Table 4-6.[3] There are no producer surplus gains expected under Alternative C, the no-action alternative. The majority of the estimated producer surplus gains occur in the PWC sales/service and rental and other retail markets under Alternatives A and B. For Alternative A, estimated producer surplus gains are between $12,680 and $97,250 for PWC sales/service and $9,260 to $20,660 for PWC rentals. Under Alternative B, producer surplus gains are estimated to range from $11,840 to $90,770 for PWC sales/service and from $8,800 to $19,630 for PWC rentals. The range of gains predicted for the other business categories, which include restaurants and bars, groceries/take-out, gasoline and oil, and souvenir/retail shops is between $0 and $2,270 depending on the business category, the alternative, and the profit ratio used. Overall, producer surplus gains are estimated to be between $22,360 and $122,240 under Alternative A and between $20,960 and $113,650 under Alternative B.

Table 4-7 summarizes the estimated change in producer surplus for the period from 2002 to 2012. The present value of estimated incremental increases in producer surplus for Alternative A ranges from $185,180 to $1,012,360 using a 3 percent discount rate and from $146,770 to $802,390 using a 7 percent discount rate. For

[3]Estimated producer surplus gains in future years have a similar distribution across industries.

Table 4-6. Changes in Producer Surplus in the First Year Resulting from PWC Use Management Alternatives in LAMR (2001$)[a]

	Alternative A		Alternative B		Alternative C	
	Low	High	Low	High	Low	High
PWC rentals	$9,260	$20,660	$8,800	$19,630	$0	$0
PWC sales/service	$12,680	$97,250	$11,840	$90,770	$0	$0
Lodging	$0	$0	$0	$0	$0	$0
Restaurants and bars	$120	$1,500	$90	$1,120	$0	$0
Groceries/take-out	$40	$270	$30	$200	$0	$0
Gas and oil	$10	$290	$10	$220	$0	$0
Souvenirs and other retail	$250	$2,270	$190	$1,710	$0	$0
Total	**$22,360**	**$122,240**	**$20,960**	**$113,650**	**$0**	**$0**

[a]All impacts were rounded to the nearest $10. Columns may not sum to totals due to rounding.

Alternative B, the present value of producer surplus increases is estimated to be between $173,590 and $941,220 using a 3 percent discount rate and between $137,580 and $746,010 using a 7 percent discount rate. Alternative C, the no-action alternative, continues baseline management of PWC and will not result in changes in producer surplus.

Uncertainty

A number of factors will affect local business revenues and the resulting estimates of changes in producer surplus associated with the proposed alternatives. Important factors include the uncertainty surrounding the baseline projections as described in Section 2.2, uncertainty concerning the estimation of output reductions as described in Section 3.3.8, and the use of national average accounting profit ratios to approximate producer surplus gains to individual local businesses.

NPS Enforcement Costs

In addition to costs incurred by PWC users and local businesses under regulation, costs may be incurred by taxpayers to support an increase in enforcement efforts by park staff. Although it is possible that additional staff may be required under Alternatives A and B relative to the baseline, the number of staff (if any) that would be hired is uncertain.

Table 4-7. Changes in Producer Surplus Resulting from PWC Use Management Alternatives in LAMR, 2003–2012 (2001$)[a]

	Alternative A		Alternative B		Alternative C	
Year	Low	High	Low	High	Low	High
2003	$22,360	$122,240	$20,960	$113,650	$0	$0
2004	$22,360	$122,240	$20,960	$113,650	$0	$0
2005	$22,360	$122,240	$20,960	$113,650	$0	$0
2006	$22,360	$122,240	$20,960	$113,650	$0	$0
2007	$22,360	$122,240	$20,960	$113,650	$0	$0
2008	$22,360	$122,240	$20,960	$113,650	$0	$0
2009	$22,360	$122,240	$20,960	$113,650	$0	$0
2010	$22,360	$122,240	$20,960	$113,650	$0	$0
2011	$22,360	$122,240	$20,960	$113,650	$0	$0
2012	$22,360	$122,240	$20,960	$113,650	$0	$0
PV (3%)[b]	**$185,180**	**$1,012,360**	**$173,590**	**$941,220**	**$0**	**$0**
PV (7%)[c]	**$146,770**	**$802,390**	**$137,580**	**$746,010**	**$0**	**$0**

[a]All impacts were rounded to the nearest $10.

[b]The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584). While the welfare impacts in this case are private goods, the 3 percent discount rate was used to be consistent with discounting of other impacts in this report.

[c]Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

Prior to November 2002, law enforcement activities associated with PWC use at LAMR were incidental to other park services. As described in Section 2.2.2, NPS staff estimate that prior to the ban, PWC made up 20 percent of watercraft in LAMR. LAMR staff indicated that the costs of enforcing PWC regulations are considered incidental to enforcement of general boating regulations, because no funding or personnel are dedicated exclusively to enforcement of PWC regulations at LAMR. Boating regulations are enforced primarily by Texas Parks and Wildlife patrols (one to six officers on summer weekends), with fewer patrols by the Coast Guard Auxiliary (one to two boats on holiday weekends) and NPS. Between 1997 and 2001, 393 written violation notices were issued

to watercraft operators on Lake Meredith. Of these notices, 271 were issued to boat operators and 122 to PWC users.

Although in the past, the enforcement of PWC regulations has been incidental to other park enforcement activities, without additional data NPS cannot be certain that allowing PWC under Alternatives A and B will not necessitate additional enforcement staff in the future. Consequently, NPS does not quantify enforcement costs associated with implementing Alternatives A and B. Alternative C, which continues baseline conditions, will not result in any additional enforcement costs for LAMR.

4.3 SUMMARY

Alternative C, the no action alternative, represents the baseline for this analysis. Under that alternative, all PWC use would be prohibited from the park. Alternative A would permit PWC use as managed in the park prior to the ban and Alternative B would permit PWC use, but with no wake zones and refueling restrictions compared with pre-ban management. The benefits of any alternative are measured relative to the baseline conditions, which are represented by Alternative C. Therefore, there are no incremental benefits associated with Alternative C. The primary beneficiaries of Alternatives A and B would be the park visitors who use PWC and the businesses that provide services to PWC users such as rental shops, restaurants, gas stations, and hotels. Additional beneficiaries include individuals who use PWC outside the park where PWC users displaced from the park may decide to ride if PWC use within the park were prohibited. Benefits accruing to individual PWC users are called consumer surplus gains, and those accruing to businesses are called producer surplus gains. Consumer surplus measures the net economic benefit obtained by individuals from participating in their chosen activities, while producer surplus measures the net economic benefit obtained by businesses from providing services to individuals. These benefits, projected over a 10-year horizon, are summarized in Table 4-8.

As with the benefits described above, the costs of any alternative are measured relative to the baseline conditions, which are represented by Alternative C. Therefore, there are no incremental costs associated with Alternative C. The primary group that would incur costs under Alternatives A and B are the park visitors who do not

Table 4-8. Present Value of Projected Incremental Benefits Under Alternatives A and B, 2003–2012

	PWC Users	Businesses	Total
Alternative A			
Discounted at 3%[a]	$4,676,120	$185,180 – $1,012,360	$4,861,300 – $5,688,480
Discounted at 7%[b]	$3,706,280	$146,770 – $802,390	$3,853,050 – $4,508,670
Alternative B			
Discounted at 3%[a]	$4,442,330	$173,590 – $941,220	$4,615,920 – $5,383,550
Discounted at 7%[b]	$3,520,980	$137,580 – $746,010	$3,658,560 – $4,266,990

[a]The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584). While the welfare impacts in this case are private goods, the 3 percent discount rate was used to be consistent with discounting of other impacts in this report.

[b]Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

use PWC and whose park experiences would be negatively affected by PWC use within the park. Non-PWC uses at LAMR include boating, canoeing, fishing, and hiking. However, these costs could not be quantified because of a lack of available data. Additionally, the public could incur costs associated with impacts from Alternatives A and B to aesthetics, ecosystem protection, human health and safety, congestion, nonuse values, and enforcement. However, these costs could not be quantified because of a lack of available data.

Because the costs of the alternatives are not quantified, the benefits presented in Table 4-8 represent the quantified net benefits of Alternatives A and B. As noted above, these net benefits do not account for the costs of enforcement; the costs to non-PWC users; or those costs relating to aesthetics, ecosystem protection, human health and safety, congestion, or nonuse values as a result of a lack of available data. Therefore, these net benefit estimates do not reflect all costs. If all costs could be incorporated, the indicated net benefits for each alternative would be lower.

From an economic perspective, the selection of Alternative B as the preferred alternative was considered reasonable because certain costs could not be quantified in the net benefits presented above.

Those costs, relating to non-PWC use, aesthetics, ecosystem protection, human health and safety, congestion, or nonuse values, would likely be greater for Alternative A than for Alternative B. Given that the quantified net benefits of Alternatives A and B were similar, further inclusion of these unquantified costs could reasonably result in Alternative B having the greatest level of net benefits. Therefore, based on these factors, Alternative B was considered to provide the greatest level of net benefits.

5 Small Entity Impact Analysis

Alternatives A and B are expected to have positive effects on small businesses relative to baseline conditions, while Alternative C has no incremental impacts.

Changes to the management of PWC use in national parks potentially affect the economic welfare of a number of businesses, large and small. However, small entities may have special problems in complying with such regulations. The Regulatory Flexibility Act (RFA) of 1980, as amended in 1996, requires special consideration be given to these entities during the regulatory process.

To fulfill these requirements, agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. This section assesses the potential for PWC regulations in LAMR to affect small businesses. Expected changes in revenues across firms and regional economic impacts are discussed in Section 3, and expected changes in producer surplus are discussed in Section 4.

5.1 IDENTIFYING SMALL ENTITIES

As described in Sections 2 and 3, NPS attempted to identify the firms in the region surrounding LAMR that would experience the most significant impacts as a result of PWC regulations in LAMR. The relatively small expected changes in total visitation to the LAMR area as a result of implementing any of the proposed alternatives suggest that there will be no noticeable regional impacts on lodging establishments and restaurants. It is possible that these tourism-related industries may experience localized impacts in communities located adjacent to LAMR, but any impacts are

expected to be small relative to the impacts estimated for businesses that provide PWC sales, rentals, and service.

In addition, there are wide variations in recreational visitation to LAMR from year to year. This variation in visitation likely causes similar year-to-year variations in revenue for local firms that rely on tourism. The fact that firms are still in business despite these low visitation/low revenue years provides some anecdotal evidence that small firms are able to remain in business even if they experience a change in revenue. The businesses most likely to be directly affected by PWC regulations are those offering PWC rental, sales, and/or services and convenience/bait/gasoline stores. NPS identified one PWC rental shop, five PWC sales and/or service firms, and four convenience/sporting goods stores located in communities near LAMR. The impacts on the PWC-related businesses considered here are believed to be representative of the upper bound of impacts that would be experienced by local businesses under Alternative A or B. Under Alternative C, the no-action alternative, no incremental impacts are expected for small businesses because it maintains baseline management conditions under which PWC were banned from LAMR in November 2002.

NPS classified 8 of the 10 identified affected firms as small for this analysis.

The SBA's general size standard definitions for NAICS 532292 (Recreational Goods Rental[1]) and NAICS 441221 (Motorcycle Dealers[2]) classify companies with annual sales less than or equal to $5 million as small. Businesses categorized as NAICS 445120 (Convenience Stores[3]) are considered small if their revenues are below $23 million; and as NAICS 451110 (Sporting Goods Stores[4]) are considered small if their revenues are below $6 million. NPS computed total revenue for each firm in one of the following ways:

[1]This industry comprises establishments primarily engaged in renting recreational goods, such as bicycles, canoes, motorcycles, skis, sailboats, beach chairs, and beach umbrellas.

[2]This industry comprises establishments primarily engaged in retailing new and/or used motorcycles, motor scooters, motor bikes, mopeds, off-road all-terrain vehicles, and PWC or retailing these new vehicles in combination with repair services and selling replacement parts and accessories.

[3]This industry comprises establishments known as convenience stores or food marts (except those with fuel pumps) primarily engaged in retailing a limited line of goods that generally includes milk, bread, soda, and snacks.

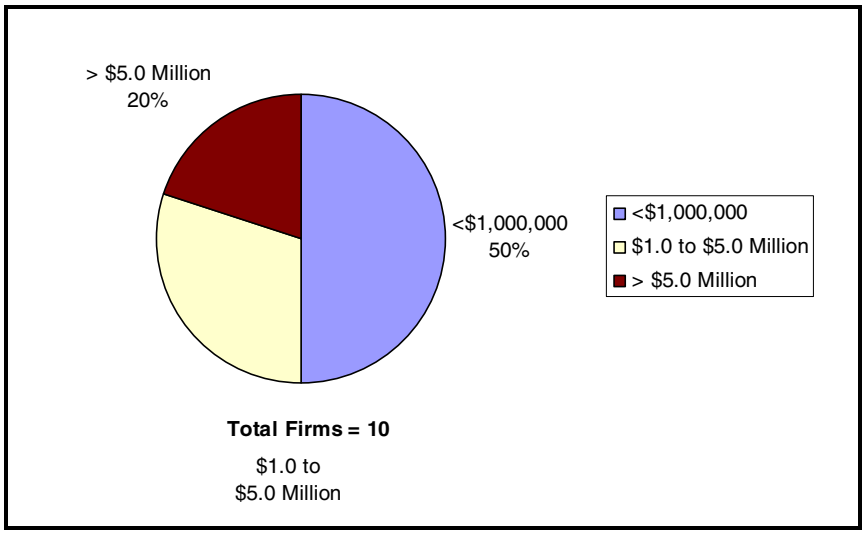
[4]This industry comprises establishments primarily engaged in retailing new sporting goods, such as bicycles and bicycle parts; camping equipment; exercise and fitness equipment; athletic uniforms; specialty sports footwear; and sporting goods, equipment, and accessories.

- Interview data—For four of the five PWC sales shops, NPS multiplied the number of PWC units sold by the average price ($7,828) of PWC (PWIA, 2002) to obtain PWC revenue. Next, we divided this estimate by the proportion of sales accounted for by PWC sales (according to information provided by these firms) to obtain total firm revenue.
- *Info*USA (2002) data—For the remaining six firms, NPS used the midpoint of the sales range reported for the firm by *Info*USA. For companies with sales less than $500,000, we assumed total company revenue equaled $250,000 (midpoint of $0 and $500,000).

Based on this approach, we estimated these 10 firms had a total of $23 million in annual revenue in 2000.

The distribution of total company sales for the 10 firms is shown in Figure 5-1. Five of these companies are estimated to have less than $1.0 million in annual sales (50 percent), three are estimated to have annual sales between $1.0 million and $5.0 million (30 percent), and two are estimated to have revenues above $5.0 million. After additional review and data collection, NPS determined one of the ten firms is owned by a large company with sales exceeding $100 million.[5] Another firm with estimated revenues exceeding $10 million was classified as large based on interview data. Therefore, NPS classified 8 of the 10 identified affected firms as small for this analysis.

Figure 5-1. Distribution of Firms by Sales Range



[5]NPS only used revenues at the firm's location in the LAMR area to estimate the producer surplus losses in Section 4.

5.2 ASSESSMENT

Do the proposed regulations have a significant negative impact on a substantial number of small entities?

Alternative A: No

Alternative B: No

Alternative C: No

After considering the economic impacts of the PWC regulations in LAMR on small entities, NPS concludes that none of the management alternatives will have a significant negative impact on a substantial number of small businesses. Alternatives A and B will have a positive impact on small businesses relative to the baseline scenario, under which PWC were banned from LAMR in April 2002. The no-action alternative (Alternative C) will not have a significant negative impact on a substantial number of small entities because it will not result in a change from baseline conditions. NPS made the determination that these management alternatives would not have a significant negative impact on small entities using RFA implementation guidance provided by other agencies (NMFS, 2000; EPA, 1999b; SBA, 2003) and provides the following factual basis for this determination:

- This rule is not expected to reduce any of the area businesses' profit margins or reduce the competitiveness of the PWC rental and retail businesses.
- NPS projects increases in revenue relative to the baseline for firms selling and renting PWC to LAMR visitors and for other firms that cater to large numbers of PWC users under Alternatives A and B.
- NPS projects higher overall levels of revenue for other businesses (restaurants, grocery stores, gas stations, and souvenir shops) in the LAMR region relative to the baseline under Alternatives A and B.
- NPS projects no change in revenue for local small businesses relative to baseline conditions under Alternative C, the no-action alternative.

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Appendix A: Economic Impact Analysis

Expenditures made by visitors to national parks have a variety of economic impacts on the region where the park is located. For instance, tourists contribute to sales, profits, jobs, tax revenues, and income in a region. The most direct effects are felt within the primary tourism sectors: lodging, dining, transportation, entertainment, and retail trade. However, when indirect effects are included, almost all sectors of the economy are affected by tourism. This occurs because spending by tourists on the primary tourist sectors leads those sectors to purchase inputs into their production process from other industries, which then purchase more inputs themselves and so on. In addition, as local household income rises because of the impact of tourism, these households purchase more goods and services from many different industries. This leads to higher incomes for households deriving income from these other industries, which causes them to purchase more goods and services as well. These feedback effects continue indefinitely, but become smaller and smaller in each round as a result of leakage because not all income is spent within the regional economy. These effects on household spending are known as induced effects.

A simple example from Stynes (2000) illustrates this point. Assume a region attracts an additional 100 tourists, each spending $100 per day. The direct impact of this increase in tourism is $10,000 per day in new spending. If sustained over a season of 100 days, the region would experience an increase in sales of $1 million. This spending would primarily take place in the lodging, dining, entertainment, and retail sectors in proportion to how each visitor spends his/her $100. Not all of the value of this spending can be

assumed to accrue within this region because the cost of goods made in other regions should not be included as a direct sales effect in the local area. For example, gasoline purchased by tourists for $1.50 per gallon should not be included as a local spending impact of $1.50 per gallon. Instead, only the retail margin on the gasoline can be considered a direct effect of tourism spending. The margins on gasoline are relatively small. Assuming a retail margin of 12 percent suggests that the direct impact of spending on gasoline to the local area is only about 18 cents per gallon. Wholesale margins are also included for wholesalers located within the region of interest.

Returning to the example above, perhaps 30 percent of the million dollars in direct spending would leak out of the area to cover the costs of goods purchased by tourists that were produced outside the region. The remaining $700,000 increase in direct sales might yield $350,000 in income within tourism-related industries and support 20 jobs directly linked to tourism. Tourism industries tend to be labor intensive, translating a relatively high proportion of sales into income and jobs.

The tourism industry buys goods and services from other industries located in the area to provide the goods and services offered to tourists. For example, changes in sales, jobs, and income in the linen industry (an industry supplying products to hotels) will result from changes in hotel sales. Also, as mentioned above, this industry is typically very labor intensive. Therefore, most of the $350,000 in income will be paid as wages and salaries to tourism industry employees. As a result of this increase in income, these employees will spend more in the local region for an array of household products and services. Assuming a sales multiplier of 2.0 to indicate that each dollar of direct sales generates another dollar of secondary sales implies that the $700,000 in direct sales within the region leads to a $1.4 million increase in regional sales as a result of the additional tourists visiting the area. These secondary sales create additional income and employment in the region, with the estimated impact dependent on the multipliers for each particular region. Assume in our case that the total impact of the increase in tourism after applying multipliers is $1.4 million in sales, $650,000 in income and 35 jobs.

Although hypothetical, the numbers used in this example are fairly typical of those used in a tourism economic impact study. Through indirect and induced effects, changes in tourist spending can affect almost every sector of the economy to some extent. The magnitude of these effects depends strongly on the extent to which businesses and households in the region purchase goods and services from local suppliers as well as how much household income is affected by the changes in spending. When a large employer closes a plant, the entire local economy may be negatively affected as retail stores close and leakages of spending from the region increase as consumers go outside the region for more of their goods and services. Similar effects in the opposite direction are observed when a new facility opens and there is a significant increase in household income (Stynes, 2000).

In addition to simply estimating the total regional impact, more detailed studies identify the sectors that receive the direct and secondary effects. They may also identify distinct market segments and identify differences in spending and impact between these subgroups. This information is sometimes used to target marketing efforts towards tourists with particular characteristics that are likely to lead to the largest economic impact per marketing dollar. It may also be used simply to better understand the distribution of impacts and to gain a better measure of the expected effects of a change in regional spending. Effects on tax revenues may also be examined by applying local tax rates to changes in sales and income.

The economic impacts resulting from a change in spending are typically measured by

- ➤ estimating the change in the number and types of visitors to the region due to the proposed change in policy,
- ➤ estimating average levels of spending (often within market segments) of visitors in the local area, and
- ➤ providing the estimated change in direct spending as input into a regional economic model to determine secondary effects.

Estimates of changes in visitor activity usually come from a demand model or professional judgment about the changes in visitation likely to take place. This step is often the weakest link in tourism impact studies because most regions do not have accurate counts of

visitors, let alone models for predicting changes in visitation (Stynes, 2000).

Spending averages are usually derived from visitor surveys or may be adapted from other similar studies. Because of differences in visitors, these data are often provided for different segments of the visitor population due to variations in spending patterns based on whether visitors stay overnight, the accommodations they choose, the type of transportation they are using, and other characteristics of their stay.

One of the primary methods used to estimate the secondary economic impacts of a particular action or policy is to apply an input-output (I-O) model. I-O models are mathematical models that describe the relationship between sectors in a region's economy. Regional I-O models are commonly used to estimate the benefits or costs of an event on the economy of a given region. These models are used to estimate linkages among sectors of the economy such that an event directly affecting one sector of the economy can be traced through the impact on the entire regional economy. This approach permits estimation of both the direct impacts in the affected sector as well as indirect impacts that occur as the change in spending by the directly affected industry works its way through the economy. Based on production functions estimating the inputs that each industry must purchase from every other industry to produce their output, these models predict flows of money between sectors. These models also determine the proportion of sales that end up as income and taxes. Multipliers are estimated from I-O models based on the estimated recirculation of spending within the region. The higher the propensity for households and firms within the region to purchase goods and services from local services, the higher the multipliers for the region will be. A number of important assumptions are involved in using I-O models. Some of the basic assumptions include the following:

- **Constant Returns to Scale.** Each industry's production function is assumed to have constant returns to scale. This means that, to produce additional output, all inputs increase proportionately (i.e., if output in an industry were to double, then that industry would double its use of all inputs). Because labor is one of the inputs into production, this implies that jobs will change in exactly the same proportion as output.

- **No Supply Constraints.** Supplies are unlimited. All industries have access to unlimited quantities of raw materials at a constant price with output limited only by demand.
- **Fixed Commodity Input Structure.** This assumption implies that price changes do not cause a firm to purchase substitute goods. This structure assumes that changes in the economy affect the industry's output but not the mix of inputs it uses to make its products.
- **Homogeneous Sector Output.** The proportion of all the commodities produced by an industry will remain the same, regardless of total output. An industry will not increase the output of one product without proportionately increasing the output of all its other products.
- **Industry Technology Assumption.** This assumption is important when data are collected on an industry-by-commodity basis and then converted into industry-by-industry data. It assumes that an industry uses the same technology to produce all of its products. In other words, an industry has a primary product and all other products are by-products of the main product.
- **Identical Firms.** All firms in a given industry employ the same production technology and produce identical products.
- **Model Parameters.** The various model parameters are accurate and represent the current year. These models rely on the national system of accounts to generate model parameters based on standard industrial classification codes and various federal government economic censuses. They are usually at least a few years out-of-date, although this is not usually a major problem unless the region has changed significantly.
- **Induced Effects.** Multiplier computations for induced effects assume that jobs created by additional spending are new jobs involving local households. The induced effects of new spending are calculated assuming linear changes in household spending with changes in income.

These assumptions are necessary to estimate an economic impact model using a typical regional I-O model. However, these assumptions lead to several limitations as noted by Hamilton et al. (1991); Coughlin and Mandelbaum (1991); and Stabler, Van Kooten, and Meyer (1988), among others. Most of these issues apply to alternative models as well and should be considered in interpreting the results of economic impact analyses in general. Some of the biggest limitations associated with this type of analysis are discussed below.

First, all production inputs have an associated opportunity cost. Thus, these opportunity costs should be included in the net benefits calculation, although this is often not considered in an economic impact analysis. Net benefits equal impacts less opportunity costs. In the case of full employment, perfect resource mobility, and absence of scale economies, benefits of a policy, action, or project would be zero because all factors employed as a result could have received the same return without the policy, action, or project in alternative uses. Typically, applications analyzing regional economic analysis assume that there is not full employment and complete mobility in the region being analyzed, but the change in net benefits will still be reduced if opportunity costs are considered.

Another issue is that multipliers estimate short-term changes, ignoring a regional economy's long-term adjustments. Thus, most of the economic effects identified in economic impact analysis are likely to be only transitory as the regional economy adjusts to the change. For example, if jobs are lost in a region because of new regulations, some of this reduction will be temporary because some of the workers whose jobs were eliminated will find new jobs in the region.[1]

Also, if some workers relocate in response to a change in the regional economy, then it is not entirely clear who should be counted in the region when calculating the benefits and costs associated with a change. For example, a new project located in a particular region may attract resources from outside the region. It is not clear that income to these immigrant resources should be counted as regional benefits of the project because people originally from the region do not benefit. However, I-O models typically make no distinction between jobs and sales, for example, going to those people already within the region and benefits going to those people outside the region.

Furthermore, applying multipliers is difficult if industries will move to different points on their cost curves as a result of the change and there are economies or diseconomies of scale. Because I-O models are based on fixed coefficients, they are not able to capture these

[1]Some workers may not find jobs within the region, even in the long run. The loss of workers who leave for jobs in other regions may tend to slow the region's growth, but such restructuring ultimately improves national economic performance by redistributing resources to their most efficient use.

impacts. These models assume that there are no supply constraints such that industries will not change their relative purchases from other sectors. This requires excess regional production capacity and excess regional labor so that use of these resources can be increased without a change in prices. In many areas, this is unlikely to be the case. Instead, increasing scale may lead to an increase in the price of labor and other resources and may cause a change in the mix of inputs used for production. It may also lead to the use of a different proportion of inputs being purchased from outside the region, which will affect the estimated change in final demand for regional output.

Some additional difficulties with applying regional multipliers include the following:

- multipliers are based on political boundaries (e.g., counties, states) instead of economic areas;
- multipliers may not be constant over time;
- different production functions for different activities are lumped together; and
- information on the relationships between producers in a region is lacking, which makes constructing an accurate set of multipliers very difficult.

Despite these caveats on the use of multipliers, regional I-O models are still considered the best way currently available to cost-effectively estimate the regional impacts of a change that will affect the local economy.

Appendix B: Social Benefits and Costs of Personal Watercraft Restrictions

The purpose of benefit-cost analysis is to evaluate the social welfare implications of a proposed action—in this case the regulation of PWC use in national parks. That is, it assesses whether the action generates benefits to society (gains in social welfare) that are greater than the costs (losses in social welfare). The following sections provide detailed descriptions of the range of social benefits and social costs that may result from PWC restrictions and discuss the ways in which these benefits and costs can be conceptualized and measured.

B.1 SOCIAL BENEFITS OF PWC RESTRICTIONS

PWC use in national parks may be associated with a number of negative impacts on environmental resources and ecosystems. One result of any negative impacts that occur is that they impose welfare losses on individuals who value the parks' environmental systems. The benefits of PWC restrictions can therefore be thought of and measured as the reduction in these losses to society. In addition, PWC use can negatively affect society in ways that are not directly related to the environment; therefore, the benefits of PWC restrictions must also include reductions in these nonenvironmental losses. Both broad categories of benefits—environmental and nonenvironmental—are discussed in more detail below.

B.1.1 Environmental Benefits

The use of PWC may have adverse impacts on the aesthetic qualities of the park, on human health, and on the park's ecosystems. The benefits associated with avoiding these impacts are described below.

Aesthetic Benefits

Among the largest and most directly damaging impacts associated with PWC use in national parks are its effects on the aesthetic qualities of park air and specifically the park soundscape. The natural soundscape is considered a natural resource of the park, and NPS attempts to prevent or minimize unnatural sounds that adversely affect the natural soundscape. National parks are especially valued for their pristine and undisturbed environments, which are often experienced by visitors through natural vistas and through the relative absence of visible or audible human activity (NPS, 2000b). The improvement or preservation of these aesthetic qualities, either in the form of reduced noise pollution or improved visibility, is therefore a potentially important source of benefits from reducing PWC use.

Noise Reduction. Perhaps the most noticeable and intrusive aspect of PWC is the level of sound they emit during normal operation. PWC have been measured to emit 65 to 105 decibels (dB) per unit, which may disturb visitors on the land and on the water. Noise limits established by NPS require vessels to operate at less than 82 dB at 82 feet (from the shoreline). The amount of noise from a PWC can vary considerably depending on its distance from another park visitor and whether it is in the water or in the air. Noise dissipates by 5 dBs for each doubling of distance from a 20-foot circle around the source and a PWC that is airborne is 15dBA louder than one that is in the water (Komanoff and Shaw, 2000). To put these noise-level estimates into perspective, Table B-1 also compares them with those of other familiar sounds.

PWC users tend to operate close to shore, to operate in confined areas, and to travel in groups, making noise more noticeable to other recreationists. Noise impacts from PWC use are caused by frequent changes in pitch and loudness due to rapid acceleration, deceleration, and change of direction. PWC noise intrudes in

Table B-1. Comparative Noise Emissions

Source	Decibel Level
Firearms	140
Motorcycle	90–110
Snowmobiles	73–100
Vacuum cleaner	70
PWC	65-105
Normal conversation	60
Normal breathing	10

otherwise quiet soundscapes, such as in secluded lakes, coves, river corridors, and backwater areas. Also, PWC use in areas where there are nonmotorized users (such as canoeists, sailors, and kayakers) causes conflicts between users.

Those who are most likely to benefit from reductions in PWC-related noise pollution in national parks are other park visitors and recreators, in particular those engaged in recreational activities that take place by the water, such as fishing, hiking, birdwatching, canoeing, kayaking, and swimming.

Several studies have shown that noise from motorized vehicles diminishes the recreational experience of other users. Several studies have found disamenities associated with various forms of mechanized recreational activities or other "technology-related" noises in recreation areas (Beal, 1994; Ivy, Stewart, and Lue, 1992; Bury and Luckenbach, 1983; Baldwin, 1970; Bury, Wendling, and McCool, 1976; Dunn, 1970; Lucas and Stankey, 1974; O'Riordan, 1977; Sheridan, 1979; Wagar, 1977).

Relatively few studies have specifically estimated the (negative) value of noise externalities on other recreators. One exception is a recent analysis conducted by the Federal Aviation Administration (FAA) to estimate the benefits of a regulation to restrict commercial air tours in Grand Canyon National Park (GRCA) (FAA, 2000). Using visitor-day value estimates from existing studies ranging from $37 to $92 (for backcountry, river, and other users of the park), the analysis assumed that these visitor-day values would be reduced in

relation to the how much aircraft noise interfered with the enjoyment of GRCA. Information about how aircraft noise affected different recreators was provided by a separate survey study of GRCA visitors. The survey found, for example, that for backcountry visitors 21 percent were "slightly" affected and 2.5 percent were "extremely" affected by the aircraft noise. In the FAA analysis, visitor value-days were assumed to be reduced by 20 to 80 percent depending on the percentage of respondents who indicated that their enjoyment of the park was "slightly," "moderately," "very," or "extremely" affected by the noise.

Another example of such a study that focuses specifically on the noise impacts of PWC is one that has examined the losses that PWC users impose on other beach recreators (Komanoff and Shaw, 2000). This study assumed that an average beach day (per person) is worth between $10 for a popular beach and $30 for a secluded one and that each 10 dB increase in background noise decreases these values by 10 percent. The assumptions about the size of the decrease in value from increases in noise come from studies on the increased property values for houses in quiet neighborhoods. Assuming also that each 1 dB noise level increment reduces the value of a beach day by 1 percent, the study found that beachgoers suffer an average loss in recreation value of between $0.50 and $7.40 per jet ski cluster (1.6 jet skis over the course of a day) per person per day.

Other evidence regarding the noise-related losses imposed by PWC can be gleaned from studies that have examined the effects of congestion on recreation values. In these studies, congestion is often measured as the number of encounters with other recreators, which may be thought of as being roughly equivalent to hearing the sound of PWC. For example, in a study of backcountry recreators in the Caribou-Speckled Mountain Wilderness in Maine, Michael and Reiling (1997) found that weekend visitors experienced losses of $22.3 (in 1990 dollars) per visit if they encountered more groups than expected.

Visibility Improvements. Several studies by the NPS and others have demonstrated the importance of visual air quality for visitors' (and nonvisitors') enjoyment and appreciation of national parks. Nevertheless, visual air quality has been and continues to be threatened at many national parks across the country. Emissions

from PWC in these parks are one of many potential (albeit, a relatively small) sources of these visibility impairments.

Although visibility effects can be characterized and measured in several different ways, "regional haze," which uniformly reduces visual range and therefore impairs the appreciation of natural vistas, has been a particular source of concern. The primary contributors to regional haze and visibility impairments in general are small particles (particulate matter or PM) in the atmosphere that scatter and absorb light. There are several different sources and types of particles in the environment; however, sulfates (and to a lesser extent nitrates), primarily from the combustion of fuels, are the largest contributors to visibility reduction, especially in the eastern portions of the U.S. (Malm, 1999). Nationwide, the largest sources of sulfur dioxide emissions that contribute to sulfates in the atmosphere are power plants and other industrial sources. Mobile sources, such as cars, trucks, and buses (and PWC), account for the largest portion of NO_X emissions, which contribute to nitrates.

Emissions factors per hour are not available for PWC but because PWC are powered by the same type (two-stroke) of engine as snowmobiles, snowmobile emissions factors may serve as a reasonable proxy. Table B-2 compares typical emissions rates for snowmobiles and other vehicles for NO_X and PM. These are the pollutants that are the most likely contributors to visibility impairments from PWC emissions. These emissions rates vary greatly across types and uses of these vehicles; however, the table shows that PM emissions for snowmobiles are particularly high relative to automobiles. The California Air Resources Board found that a 7-hour ride on a PWC powered by a conventional two-stroke engine produces the same amount of smog-forming emissions as over 100,000 miles driven in a modern passenger car. It should also be noted, however, that automobiles account for a very small portion of PM emissions nationwide.

The estimates in Table B-2 suggest that PWC can be a source of visibility impairment in national parks, but their contribution to overall levels of regional haze in these areas is likely to be negligible. Nevertheless, in high-use areas and periods, they may negatively affect visual air quality in a noticeable way.

Table B-2. Comparative Emissions Factors for Snowmobiles and Other Vehicles: NO_x and PM

	NO_x	PM
Snowmobiles (lbs per 4 hr visit)	0.06	0.2
Automobiles (lbs per 4 hr drive[a])	0.09–0.41	0.02
Diesel buses (lbs per 4 hr drive[a])	3.22	0.26

[a]Assuming an average speed of 25 mph.

Source: National Park Service (NPS). February 2000a. *Air Quality Concerns Related to Snowmobile Usage in National Parks*. Denver, CO.

Several studies have investigated U.S. households' values for improvements in visibility at various national parks across the country. All of these studies have found a significant WTP by both users and nonusers for visibility improvements. One study in particular (Chestnut and Rowe, 1990) found that the average household in the southeast U.S. would be willing to pay $68 (in 1999 dollars) per year for a doubling of the visual range in national parks in the southeast U.S.

Human Health Benefits

In addition to NO_x, ozone, and PM, PWC emissions typically contain a number of other pollutants, including CO, a conventional air pollutant that is commonly associated with mobile sources. It also includes a number of potentially toxic HC pollutants—benzene, 1,2-butadiene, formaldehyde, and acetaldehyde—and ammonia. As described in Table B-3, inhalation of these pollutants is associated with a wide variety of potential adverse health effects.

The extent to which the health effects listed in Table B-3 result from PWC emissions depends on the level and duration of exposure. Unfortunately, there is too little data and too much uncertainty to reliably estimate the incidence of these health effects. For comparative purposes, however, Table B-4 compares emissions rates of HCs and CO for snowmobiles (as in Table B-2, snowmobile emissions factors serve as a proxy for those of PWC) and for other vehicles.

The comparisons for CO are particularly relevant since highway vehicles account for over 50 percent of total CO emissions in the country (EPA, 2000b). Although the measures of vehicle use in the emissions factors are different across vehicles, the rates of HC and

Table B-3. Health Effects Associated with Pollutants in PWC Emissions

	Carcinogenic Effects	Other Chronic Health Effects	Acute Health Effects
Particulate matter (PM)	None	Chronic bronchitis	High-level exposure: mortality, acute bronchitis Low-level exposure: cough
Carbon monoxide (CO)	None	Aggravation of cardiovascular disease	High-level exposure: visual and mental impairment
Nitrogen oxides (NO_X)	None	Reduced pulmonary function	High-level exposure: cough, fatigue, nausea Low-level exposure: lung irritation
Benzene	Known human carcinogen	Anemia and immunological disorders	High-level exposure: dizziness, headaches, tremors
1,3-Budatdiene	Probable human carcinogen	Birth defects, kidney and liver disease	High-level exposure: neurological damage, nausea, headache Low-level exposure: eye, nose, throat irritation
Formaldehyde	Probable human carcinogen	NA	NA
Acetaldehyde	Possible human carcinogen	Anemia	High-level exposure: pulmonary edema, necrosis Low-level exposure: eye, skin, lung irritation
Ammonia	None	NA	High-level exposure: eye and lung irritation

NA = Not available

Sources: U.S. Environmental Protection Agency (EPA). Integrated Risk Information System. <http://www.epa.gov/ngispgm3/iris/index.htm.>. As obtained on October 15, 2000a.
U.S. Environmental Protection Agency (EPA). 1999a. *1997 National Air Quality: Status and Trends*. Washington, DC: Office of Air and Radiation.

Table B-4. Comparative Emissions Factors for Snowmobiles and Other Vehicles: HC and CO

	HC	CO
Snowmobiles (lbs per 4 hr visit)	19.84	54.45
Automobiles (lbs per 4 hr drive[a])	0.09–0.44	0.75–3.24
Diesel buses (lbs per 4 hr drive[a])	1.23	4.45

[a]Assuming an average speed of 25 mph.

Source: National Park Service (NPS). February 2000a. *Air Quality Concerns Related to Snowmobile Usage in National Parks*. Denver, CO.

CO emissions for snowmobiles are distinctly higher than for automobiles and diesel buses. As a result, national park visitors recreating near areas where PWC use is permitted may be exposed to particularly high levels of CO and certain HCs.

Restrictions on PWC use in national parks could potentially reduce harmful exposures to park visitors and workers, particularly for individuals who spend extended periods in high-use areas. The benefits of these restrictions can be expressed as the value of reductions in the incidence (i.e., the number of cases avoided) of harmful health effects, in particular those effects described in Table B-3. As previously mentioned, the total number of avoided health effects is not known; however, using information from a recent EPA study of the benefits of air pollution regulations (EPA, 1997), Table B-5 provides a summary of "unit" values for selected health effects. Based on a review and synthesis of several health valuation studies, these values represent best estimates of individuals' average WTP to avoid a single case of the health effect. In the absence of more complete information on the total health benefits of reducing PWC use, these values provide a rough sense of the magnitude and relative size of the benefits associated with avoiding specific health effects that may result from acute exposures.

Table B-5. Unit Values for Selected Health Effects

Health Effect	Unit Value (mean estimate) (1999$)[a]
Acute bronchitis	$57
Acute asthma	$41
Acute respiratory symptoms	$23
Shortness of breath (one day)	$6.8

[a]All amounts inflated using the consumer price index available from the U.S. Bureau of Labor Statistics. 2002. Consumer Price Index. Series ID CUUR000SA0. <http://146.142.24/cgi-bin/surveymost>. As obtained on January 23, 2002.

Ecosystem Protection Benefits

To the extent that damages to park ecosystems occur, their cumulative effect is to reduce the "ecological services" that these systems provide to individuals and households across the country.

National park ecosystems are particularly valued for their unique biological, cultural, and geological resources and the recreational and other services they provide. A vast majority of park visitors (i.e., users) experience and enjoy the natural systems of the park through a wide variety of recreational activities (wildlife viewing, hiking, fishing, as well as using PWC). However, even individuals who are not park visitors (i.e., nonusers) can benefit from the knowledge that park resources are being protected and preserved. These nonuse values can stem from the desire to ensure others' enjoyment (both current and future generations) or from a sense that these resources have some intrinsic value. Evidence of such nonuse values for park protection is provided in studies that have documented significant WTP by nonusers for improved air quality at parks (e.g., Chestnut and Rowe, 1990) and, more generally, for the protection of unique species and ecosystems (see, for example, Pearce and Moran [1994] for a review of such studies). Restrictions on PWC use in national parks can therefore provide benefits to both users and nonusers in a number of ways by protecting the parks' ecological resources.

B.1.2 Nonenvironmental Benefits

Restrictions on PWC use in national parks can also improve societal welfare in ways that are not directly related to environmental quality in and around the parks. These potential nonenvironmental benefits are described below.

Public Safety Benefits

With the increase in PWC use in recent years has come an increased concern relating to the health and safety of operators, swimmers, snorkels, divers, and other boaters. A study conducted by the National Transportation Safety Board (NTSB) in 1998 revealed that although recreational boating fatalities have been declining, PWC related fatalities have increased in recent years (NTSB, 1998). PWC accident statistics provided by the U.S. Coast Guard supports the increase in PWC-related fatalities. Within the U.S. five PWC-related fatalities occurred in 1987 and 68 PWC-related fatalities occurred in 2000. However, the peak occurred in 1997, with 84 PWC-related fatalities. Since 1997, PWC-related accidents, injuries, and fatalities have decreased. Following this same pattern, the percentage of PWC out of all boats involved in

accidents have decreased from 36.3 percent in 1996 to 29.6 percent in 2000. The increases and decreases in PWC accidents, injuries, and fatalities are comparative to the number of PWC sales and number of PWC owned (Schmidt, 2001).

Restrictions on PWC use in national parks would certainly reduce the number of such incidents in the parks.[1] The primary beneficiaries would be the PWC users themselves, whose safety would be protected; however, these benefits may be implicitly accounted for in the consumer surplus changes (see Section B.2) that these recreators experience as a result of the restrictions.[2] Other summer recreators (non-PWC) might also benefit if they would otherwise be at risk of being involved in accidents with PWC. In addition, PWC accidents can impose costs on NPS and other local state and local government agencies that are responsible for providing medical, rescue, and related assistance. Reductions in PWC accidents in national parks would therefore allow some of the resources devoted to these activities to be diverted to other publicly beneficial uses.

Avoided Infrastructure Costs

Allowing PWC in national parks requires NPS to develop, maintain, and operate an infrastructure to support these activities. In particular launch sites and buoys must be designated, maintained, and monitored. The costs associated with these activities vary widely across parks, depending on the physical characteristics of the parks and the level of PWC use permitted.

By restricting PWC use, some of these infrastructure-related costs can be avoided or reduced. As a result some of the resources devoted to these activities can also be diverted to other publicly beneficial uses.

[1] The benefits of these reductions may be offset to some degree by increased PWC usage and accidents in areas outside the parks.

[2] To the extent that PWC users are aware of the safety risks they face, the potential losses to themselves from accidents should already be factored into their consumer surplus from using a PWC. This implies that the safety benefits to these individuals from reducing PWC use are implicitly accounted for (i.e., deducted from) the consumer surplus losses to these recreators.

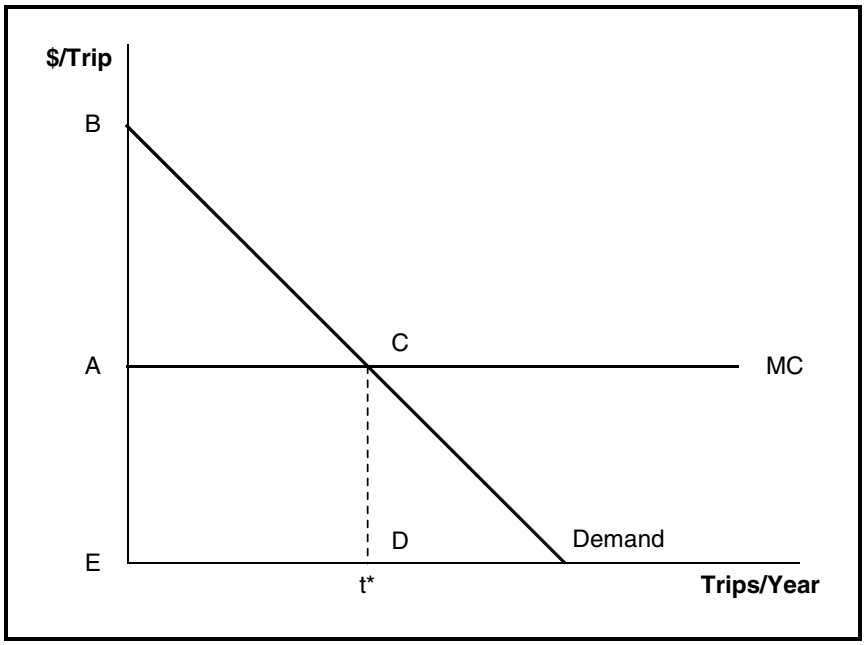
B.2 SOCIAL COSTS OF PWC RESTRICTIONS

The primary losses associated with PWC use restrictions in national parks will accrue to

- ➤ PWC users, in particular individuals who will not PWC in the park as a direct result of the restrictions, and
- ➤ providers of PWC-related services for park visitors.

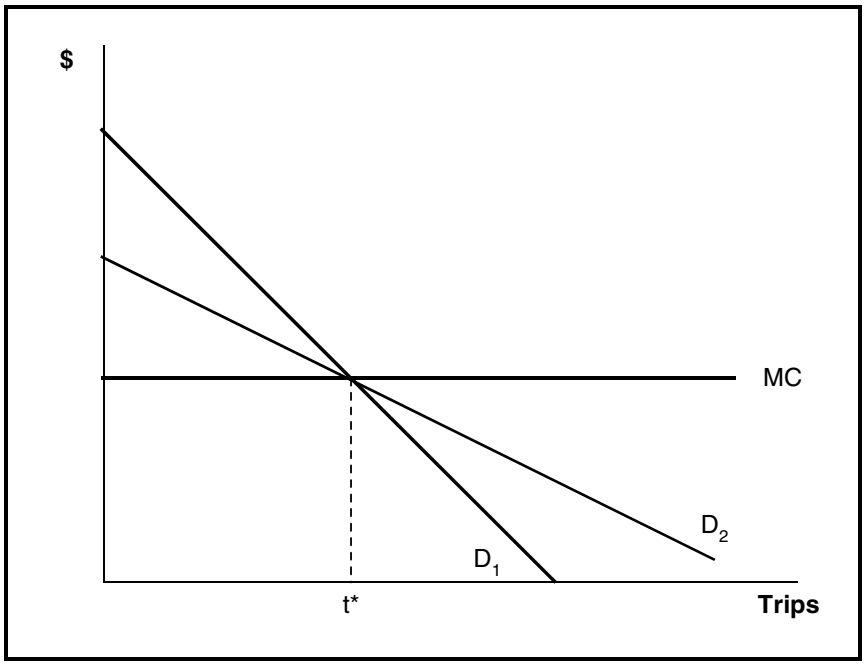
The welfare losses to individual consumers (PWC riders) are measured by their loss in consumer surplus. Consumer surplus is measured as the difference between the total cost of a product or activity to the consumer and the total amount the individual would be willing to pay for that activity. In the context of recreation activities, Figure B-1 depicts an individual demand curve for PWC trips, the marginal cost of a trip (MC, assumed to be constant), and the optimal number of trips per year, t*. The triangle ABC measures the consumer surplus associated with this optimal number of trips—the difference between what the individual paid for the trips, ACDE, and the total WTP for the trips (the area underneath the demand curve), EBCD.

Figure B-1. Consumer Surplus



The extent of the welfare loss to an individual rider depends crucially on the availability of substitute activities. Figure B-2 depicts two alternative demand curves for PWC trips to a particular waterbody. The slope of the demand curve reflects the number of substitute activities available to a particular individual and the preferences of that individual toward those substitutes. The flatter demand curve, D_2, indicates that this individual has a variety of close substitutes for PWC use in this area (these substitutes could include PWC riding in a different area or participating in a different activity such as motorboating). The individual with the steeper demand curve, D_1, has fewer substitute activities he/she enjoys as much as using his/her PWC in this waterbody. If both individuals choose the same number of trips, as in Figure B-2, the person with the steeper demand curve, D_1 (fewer substitutes for PWC use) receives greater consumer surplus from use in this particular waterbody and thus will experience a greater loss in welfare if the waterbody is closed.

Figure B-2. Consumer Surplus and Substitute Activities



The change in welfare for businesses is measured by producer surplus, or the area AP*B in Figure B-3, where P* is the market price of the good, for example a PWC rental. Producer surplus measures the difference between total revenue and variable costs. If the firms face an upward- sloping marginal variable cost (MC) curve, then a decrease in demand, indicated in Figure B-4 from D to D′ will result in a lower producer surplus for PWC rental companies.

Figure B-3. Producer Surplus

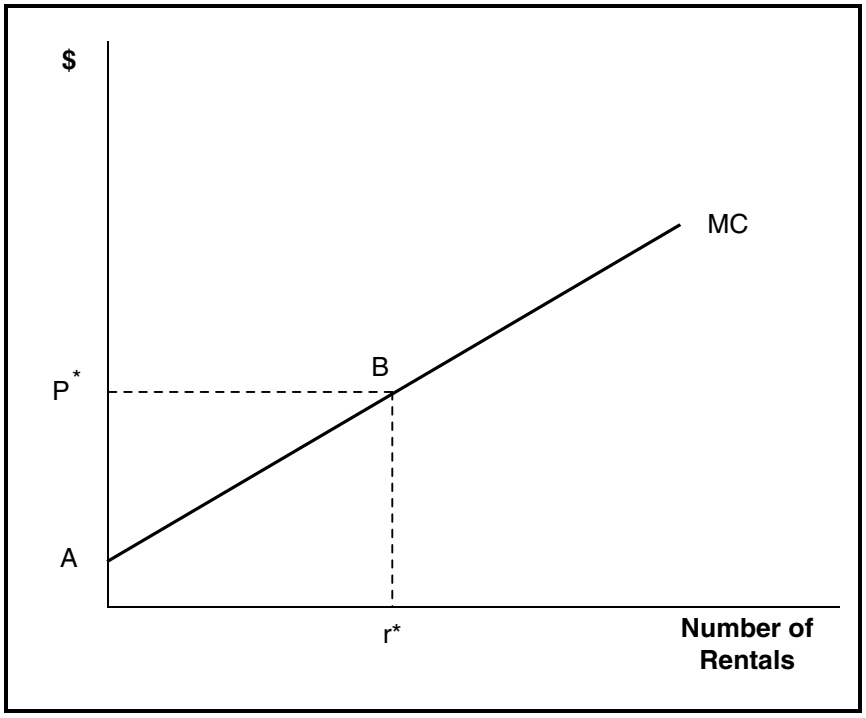
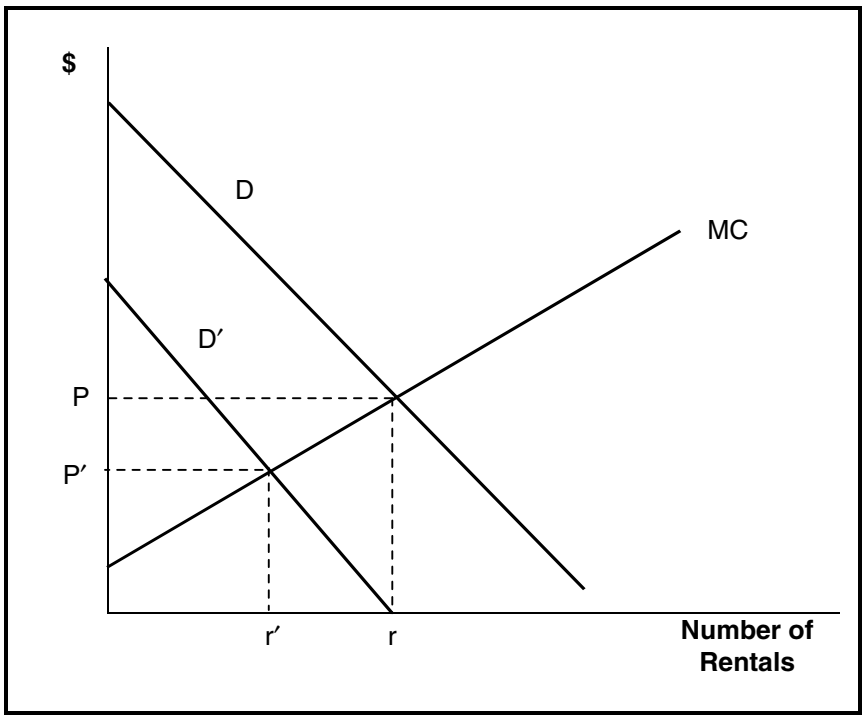


Figure B-4. Producer Surplus and a Change in Demand



If PWC riding decreases as a result of the regulation, then the suppliers of PWC and other tourism-related services will be affected, including rentals and sales of PWC and PWC accessories, lodging, meals, and other tourism-related expenditures. If demand for other types of recreation related rentals increases, then some businesses may experience an offsetting increase in producer surplus.